

15 October 1983

Effective 15 November 1983

Safety

Policies and Procedures for Firing Ammunition for Training, Target Practice, and Combat

Summary. This revision clarifies requirements on ranges for officers in charge and range safety officers, incorporates revised ballistic data affecting surface danger zone diagrams for small arms, incorporates new standardized range design for hand grenade ranges, and clarifies combined arms live fire exercises and laser operations.

Applicability.

a. This regulation applies to—

(1) The Active Army, United States Military Academy (USMA), Army National Guard, US Army Reserve, and Army Reserve Officers' Training Corps (ROTC) in range or firing activities located on or within a military installation.

(2) All Marine Corps activities of the regular establishment and to all units of the Marine Corps Reserve. Chapter 13, 16 and 19 apply to all Marine Corps units unless the requirements conflict with US Navy or local aerial range regulations, in which case the US Navy or local range regulations will take precedence.

(3) All training and target practice activities.

(4) All military real estate areas that are being or have been used as bombing ranges; artillery impact areas; target areas; and other areas exposed to contamination by military explosives, chemicals, or other dangerous materials.

b. The requirements of this regulation are advisory for actual combat conditions.

c. US Army Training and Doctrine Command (TRADOC) test organizations will comply with the provisions of this regulation unless HQ TRADOC, ATEN-S, grants a specific waiver.

d. Except for airspace safety requirements (para 2-2) and water traffic requirements (para 2-3), this regulation does not apply to development, proof, and function test ranges and laboratories of the US Army Materiel Development and Readiness Command (DARCOM); however, the necessary precautions will be taken to insure the preservation of life and property.

Impact on New Manning System. This regulation does not contain information that affects the New Manning System.

Supplementation. Supplementation of this regulation is prohibited unless prior approval of US Army Training and Doctrine Command, ATTN: ATEN-S, Fort Monroe, VA 23651.

Interim changes. Interim changes to this regulation are not official unless they are authenticated by The Adjutant General. Users will destroy interim changes on their expiration dates unless sooner superseded or rescinded.

Suggested improvements. The proponent agency of this regulation is the US Army Training and Doctrine Command. Army users are invited to send comments and suggested improvements on DA Form 2028 (Recommended Changes to Publications and Blank Forms) directly to Commander, US Army Training and Doctrine Command, ATTN: ATEN-S, Ft Monroe, VA 23651; Marine Corps activities to the Commandant of the Marine Corps (Code OT), Headquarters, US Marine Corps, WASH, DC 20380.

Contents

	Paragraph	Page		Paragraph	Page
Chapter 1					
General			Trespassing on range areas	2-5	2-2
Purpose	1-1	1-1	Range guards or barriers	2-6	2-2
References	1-2	1-1	Warning signals and signs	2-7	2-3
Responsibilities	1-3	1-1	General limitations	2-8	2-3
Explanation of terms	1-4	1-1	Range clearance operations	2-9	2-3
Special instructions	1-5	1-1	Education	2-10	2-3
Waivers	1-6	1-1	Police of ranges	2-11	2-4
Chapter 2			Chapter 3		
Ranges			Ammunition		
Range safety	2-1	2-1	Ammunition positioning and issuance	3-1	3-1
Airspace safety requirements	2-2	2-1	Ammunition qualification or restriction	3-2	3-1
Water traffic requirement	2-3	2-2	Suspension of ammunition and explosives involved in malfunctions	3-3	3-2
Notice of firing	2-4	2-2			

* This regulation supersedes AR 385-63, 22 February 1978.

	Paragraph	Page		Paragraph	Page
Disposition of materiel involved in malfunctions	3-4	3-2	Combined arms live fire exercise (CAL-FEX)	11-3	11-2
Chapter 4			Service practice	11-4	11-2
Firing			Surface danger zone	11-5	11-2
General	4-1	4-1	Operational safety factors	11-6	11-4
Range safety	4-2	4-1	Malfunctions	11-7	11-5
Who may be an OIC or RSO	4-3	4-1	Misfire, hangfire, and cookoff	11-8	11-5
Firing conditions	4-4	4-1	Excessive pressures in cannon	11-9	11-5
Duties of the OIC	4-5	4-2	Improved conventional munitions	11-10	11-5
Special firing considerations	4-6	4-2	Antipersonnel ammunition (Beehive)	11-11	11-5
Destruction of dud ammunition	4-7	4-2	M31 field artillery trainer	11-12	11-5
Other range usage	4-8	4-3	M712 Cannon Launched Guided Projectile (Copperhead)	11-13	11-6
Control of spectators and military family members (MFM) on firing ranges	4-9	4-3	Chapter 12		
Chapter 5			Tank Gunnery		
Targets			General	12-1	12-1
Moving targets	5-1	5-1	Safety program	12-2	12-1
Waterborne targets	5-2	5-1	Firing requirements	12-3	12-1
Ballistic aerial target system (BATS)	5-3	5-1	Surface danger zones for tank cannon	12-4	12-1
Chapter 6			SHILLELAGH	12-5	12-1
Small Arms and Machineguns			Surface danger zones for subcaliber tank gunnery devices	12-6	12-2
Small arms and machinegun fire	6-1	6-1	Grenade launchers	12-7	12-2
Overhead fire	6-2	6-1	Weapons effect signature simulator (WESS)	12-8	12-2
Safety from ricochets	6-3	6-1	Designation of firing status of tanks, M551s and CEVs	12-9	12-2
Shotgun ranges	6-4	6-1	Close support of ground troops in a live fire exercise	12-10	12-2
Chapter 7			Chapter 13		
Hand Grenades and Rifle Grenades			Aerial Gunnery		
Hand grenades (fragmentation and offensive)	7-1	7-1	Safety measures for firing exercise	13-1	13-1
Grenade, hand chemical	7-2	7-1	Range requirements	13-2	13-1
Rifle grenades	7-3	7-1	Firing requirements	13-3	13-2
40mm grenade launcher M79 and M203; MK19, 40mm MG (grenade)	7-4	7-1	Aerial gunnery	13-4	13-2
Surface danger zones	7-5	7-2	Aerial rocketry	13-5	13-2
Chapter 8			Aerial missilery	13-6	13-3
Rockets			Chapter 14		
Firing conditions	8-1	8-1	Air Defense Weapons		
66mm LAW, M72 series; 66mm incendiary rocket, M74; and 35mm subcaliber practice rocket, M73	8-2	8-1	Safety measures for air defense automatic weapons	14-1	14-1
3.5-inch rocket launcher	8-3	8-1	Conduct of firing	14-2	14-1
Chapter 9			Target missiles	14-3	14-1
Recoilless Weapons			Chapter 15		
Firing conditions	9-1	9-1	Flamethrowers		
Surface danger areas	9-2	9-1	Firing restrictions	15-1	15-1
Chapter 10			Surface danger zone	15-2	15-1
Mortars			Chapter 16		
60mm, 81mm and 4.2-inch mortars	10-1	10-1	Live Fire Exercises		
4.2-inch mortar	10-2	10-1	Safety during live fire exercises	16-1	16-1
Surface danger areas for mortars	10-3	10-1	Information for commanders	16-2	16-1
Chapter 11			Exercise planning	16-3	16-1
Artillery			Firing precautions	16-4	16-2
Safety measures for combined arms live fire exercises (CALFEX) and service practice firings	11-1	11-1	Fire control	16-5	16-3
Safety certification program	11-2	11-1	Maneuver in the temporary impact areas	16-6	16-3
			Air support	16-7	16-4

	Paragraph	Page		Paragraph	Page
Chapter 17					
Chemical Agents, Smokes, and Aircraft Spray			Cratering	18-10	18-4
General restrictions	17-1	17-1	Training in priming demolition blocks and other bare charges	18-11	18-4
Firing precautions	17-2	17-1	Mines, fuzes, firing devices, trip flares, and simulators	18-12	18-4
CS (O-chlorobenzalmalononitrile) riot control agents	17-3	17-1			
Smoke	17-4	17-1	Chapter 19		
Aircraft spray	17-5	17-2	Lasers		
Chapter 18			General	19-1	19-1
Mines, Firing Devices, Trip Flares, Simulators, and Explosive Charges			Hazards	19-2	19-1
General	18-1	18-1	Laser devices	19-3	19-1
Firing precautions	18-2	18-1	Responsibilities	19-4	19-1
Temporary storage in training areas	18-3	18-1	User level laser instructions	19-5	19-2
Firing	18-4	18-1	Range control procedures	19-6	19-2
Preparation of pits and setting charges ..	18-5	18-1	Laser surface danger zone (LSDZ)	19-7	19-3
Missile hazard	18-6	18-2	Airborne laser operations	19-8	19-3
Blast effect	18-7	18-3	Operation outside range area	19-9	19-3
Charges placed on steel and concrete	18-8	18-3	Tactical exercises	19-10	19-4
Firing of shaped charges, bangalore torpedoes, mine-clearing snakes, and blast-driven earth rod	18-9	18-3			
			Appendixes		
			A. References	A-1	
			B. Laser Information for Unit Laser Range		
			Safety Officers	B-1	
			Glossary	Glossary 1	

Chapter 1 General

1-1. Purpose

This regulation prescribes general safety precautions necessary to minimize the possibility of accidents in the firing and other uses of ammunition and explosives by troops in training, target practice, and as much as possible, combat and range operations, including range clearance.

1-2. References

Required and related publications are listed in appendix A.

1-3. Responsibilities

a. Commanding General, US Army Training and Doctrine Command (TRADOC); Commanding General, US Army Forces Command (FORSCOM); Commanding General, US Army Materiel Development and Readiness Command (DARCOM); Commanding generals of oversea commands are responsible for assuring that range safety procedures are established consistent with this regulation.

b. The Commanding Generals of Fleet Marine Forces, Atlantic and Pacific; commanding generals of all supporting establishment commands; and the Commanding Generals of the 4th Marine Division and the 4th Marine Aircraft Wing are responsible for assuring that range safety procedures are established consistent with this regulation.

1-4. Explanation of terms

Abbreviations and special terms used in this regulation are explained in the glossary.

1-5. Special instructions

a. Instructions and dimensions for surface danger zone diagrams (safety fans) will be developed and specific danger areas will be indicated. The depicted surface danger zones are the minimum requirements. They are adequate only when employed with properly functioning safety equipment and devices, and when trained and competent personnel follow firing procedures (See sample drawings in figs 1-1 and 1-2).

b. In training with ammunition and explosives, general firing requirements will be followed. However, under certain conditions, specific types of firings may be conducted at locations having less land or air area than required. By employing additional controls and limiting the types of firings, the desired firing can sometimes be achieved under less restrictive conditions. (see waivers in para 1-6.)

c. The following types of procedures must be developed:

(1) Standing operational procedures (SOP) for the safe firing of specific munitions and explosive devices.

(2) Operational procedures for planning and conducting range clearance operations.

(3) Local procedures or regulations designed to minimize the potential for personal injury and property damage that prescribe or refer to additional precautions in applicable technical manuals (TMs) and field manuals (FMs) for the particular weapon, munition, explosive device, and classes of fire.

d. During prefiring preparations and firing, all munitions, components, and explosives will be handled according to the applicable TMs and FMs.

e. Any person who observes a condition that makes firing dangerous will promptly command CEASE FIRING and will give the locally prescribed signal for cease firing to the firing unit. This command signal will be included in the local firing SOP.

f. Accidents caused by firing or evidence that would indicate that the safety provisions of this regulation are inadequate will be reported by letter. The letter must give all pertinent information on the alleged inadequacy of the regulation (exempt report, para 5-2*n*, AR 335-15).

(1) Army activities will send reports to the Commander, US Army Training and Doctrine Command, ATTN: ATEN-S, Fort Monroe, VA 23651.

(2) Marine Corps activities will send reports through the normal chain of command in accordance with MCO 8025.1 to the Commandant of the Marine Corps (Code T), Washington, DC 20380.

(3) National Guard activities will send reports to the Chief, National Guard Bureau, ATTN: ARNG Safety Office (NGB-AVN-S), Aberdeen Proving Ground, MD 21010.

1-6. Waivers

a. The following persons may waive safety criteria of this regulation if it is acceptably safe and is in the best interest of the United States.

(1) Commander of each major Army command (MACOM).

(2) Superintendent, USMA.

(3) Chief, National Guard Bureau.

(4) Commanding generals of Fleet Marine Force, Atlantic.

(5) Fleet Marine Force, Pacific.

(6) All Marine Corps recruit depots, air stations, air station (helicopter).

b. Airspace requirements may be waived by the Federal Aviation Administration (FAA) only.

c. Water traffic requirements, as they apply to firing over navigable waters, may be waived by the US Army Corps of Engineers only.

d. The authority delegated to a commanding general may be subdelegated to a general officer in a command position. This authority may not be further subdelegated. An installation commander delegated waiver authority will be limited to—

(1) Reducing the dimensions of surface danger areas when the terrain, artificial barriers, or other controlling factors make smaller areas safe.

(2) Modifying prescribed firing procedures appropriate to the training of participating troops to increase realism in training.

e. Commanders of each MACOM; the Chief, National Guard Bureau; and the Commandant of the Marine Corps may communicate directly with the CG, TRADOC (ATEN-S). They will obtain technical information that will help them to determine if it is advisable to grant waivers. When feasible, any range that fails to meet requirements will be redesigned, rebuilt, or relocated. A central register of waivers granted will be maintained at the MACOM level. It will be reviewed annually for corrections made. Marine Corps commanders will submit requests for technical assistance through normal chain of command channels to the Commandant of the Marine Corps (Code LMG).

f. The waiver authority does not affect the waiver responsibility in AR 385-62 and AR 385-64. It does not permit waiver of airspace safety requirements (para 2-2) and water traffic requirements (para 2-3).

g. The range safety planning for the firing of any ammunition or explosives must include the type of ammunition or explosives, the available terrain, purpose of the firing, atmospheric conditions, adequacy of safety equipment, and procedures. Projectiles or debris caused by firing ammunition or explosives must be contained

within the boundaries of the surface danger zone.

h. Only personnel thoroughly trained and qualified in firing ammunition complete rounds or their components will take part in combat firing and combined arms exercises. This will be on special courses designated for mental conditioning for actual combat.

i. When the technical assistance of TRADOC, the Commandant of the Marine Corps, or Chief, National Guard Bureau (*e* above) is requested, the MACOM will furnish, in writing, the following data to assist in evaluation.

(1) A statement citing the paragraph of this regulation to be waived.

(2) Description of conditions, scaled maps showing distances to internal and external exposures, topographical maps of the area, personnel involved, and facilities exposed.

(3) The type of ammunition and weapons as identified in proper technical manuals.

(4) Map coordinates of the firing position and quadrant elevation of fire. The firing position and direction of fire will be plotted on the scaled map and a scaled surface danger zone will be furnished as an overlay for the map. All distances will be shown in meters.

(5) An SOP for firing and range control.

(6) Other precautions that will be taken to achieve safety in operations to fully compensate for the lack of compliance with this regulation.

(7) Profiles through the gun-target-line showing the relative elevation of the piece to be fired, the target, and earthen backstop, if any. Also, furnish profiles from the firing position through the right and left limits of fire.

(8) A MACOM position statement recommending approval or disapproval or modification of the basic request for training.

SURFACE DANGER ZONE

Surface danger zone. That segment of the range area which is endangered by a particular type of weapon firing and which consists of the following areas:

(1) **Dispersion pattern.** The distribution of a series of rounds fired from one weapon or group of weapons under conditions as nearly identical as possible, the points, bursts, or impacts being dispersed about a point called the center of impact.

(2) **Impact area.** The primary danger area for indirect fire weapons that is established for the impact of all rounds. When applied to direct fire weapons, it is the area located between established range limits. The impact area is within the approved surface danger zone.

(3) **Ricochet area.** The area between the impact area and Area A (or Area G, when applicable) which parallels the line of fire and which is provided to contain ricochet projectiles.

(4) **Area A.** The area (secondary danger area) which parallels the impact area laterally and which is provided to contain fragments from items exploding or ricocheting on the right or left edge of the impact area.

(5) **Area B.** The area (secondary danger area) which is on the downrange side of the impact area and Area A. It is designed to contain fragments from items exploding on the far edge of the impact area.

(6) **Area F.** The area which is immediately to the rear of a weapon or group of weapons and which is endangered by the effects of the weapons being fired.

(7) **Rear range.** The area to the rear of the firing position.

(8) **Gun target line.** An imaginary straight line drawn between the gun and the target.

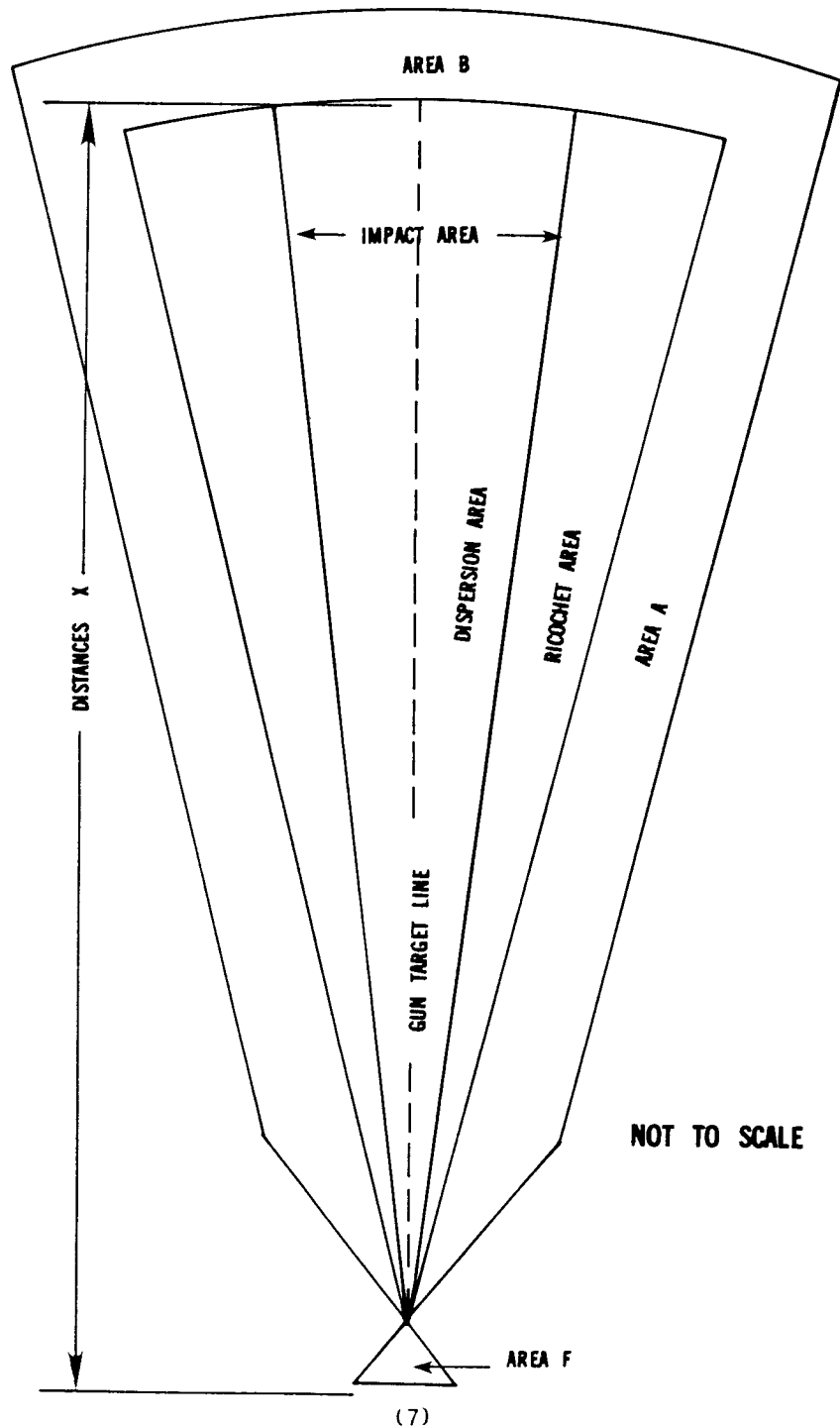


Figure 1-1. Sample explanation—Direct fire mode

SURFACE DANGER ZONE

Surface danger zone. That segment of the range area which is endangered by a particular type of weapon firing and which consists of the following areas:

(1) **Target area.** The point or location to which the weapon is to be fired. (For demolitions, the target area is the point or location at which the demolition charge is emplaced.)

(2) **Impact area.** The primary danger area for indirect fire weapons that is established for the impact of all rounds. When applied to direct fire weapons, it is the area located between established range limits. The impact area is within the approved surface danger zone.

(3) **Probable error.** Measure of the impact distribution in the dispersion pattern around the center of impact, dimensionally expressed in firing tables as one interval of the dispersion rectangle.

(4) **Area A.** The area (secondary danger area) which parallels the impact area laterally and which is provided to contain fragments from items exploding or ricocheting on the right or left edge of the impact area.

(5) **Area B.** The area (secondary danger area) which is on the downrange side of the impact area and Area A. It is designed to contain fragments from items exploding on the far edge of the impact area.

(6) **Area C.** The area (secondary danger area) which is on the uprange side of the impact area and parallel to Area B and which is intended to contain fragments from items exploding at the near edge of the impact area (also referred to as the short limit of the target area).

(7) **Area D.** The area which is between Area C and Area E and which is considered a safe area for troop occupation for training purposes.

(8) **Area E.** The area which is between Area D and the firing position and which is endangered by muzzle debris, overpressure, and injurious noise levels. Area E may be occupied only by weapon crews firing from an approved tactical configuration (circular, box, star, etc.).

(9) **Near edge.** The boundary of the impact area which borders Area C and is nearest to the firing position.

(10) **Far edge.** The boundary of the impact area which borders Area B and which is farthest from the firing position.

(11) **Downrange.** All areas of the surface danger zone which are located beyond the target point or center of a target area for multiple targets.

(12) **Uprange.** All areas of the surface danger zone which are located between the firing position and the target point or center of a target area for multiple targets.

(13) **Rear range.** The area to the rear of the firing position.

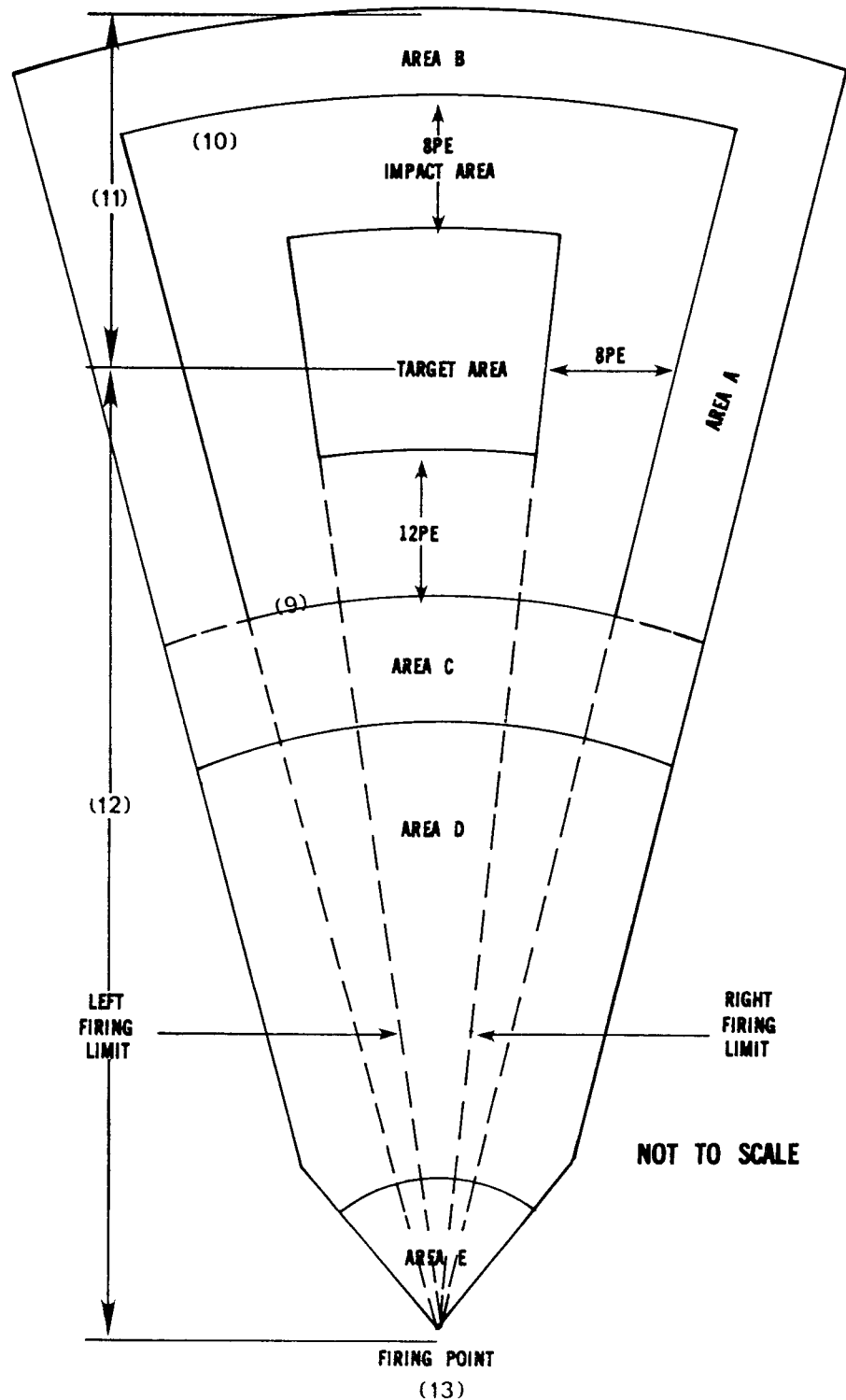


Figure 1-2. Sample explanation—Indirect fire mode

Chapter 2 Ranges

2-1. Range safety

Installation commanders will establish a range safety program. The commander will—

a. Appoint qualified range control personnel to monitor and enforce range safety and operational requirements.

(1) The range control officer (RCO) (together with the other range control personnel) will enforce the installation range safety program.

(2) The installation command safety manager will monitor the effectiveness of enforcement of the installation range safety program.

b. Publish local SOPs for the safe operation and use of ranges and training facilities.

c. Maintain and police ranges, maneuver areas, and training facilities.

d. Notify installation personnel and the public of firing and exercises involving possible hazard to the public.

e. Coordinate and schedule all firing.

f. Establish procedures for controlling and coordinating use of airspace.

g. Survey and post range boundaries and off-limit areas to prevent trespass and entry by unauthorized personnel into surface danger zones and impact areas.

h. Clear duds from ranges before allowing people to enter.

i. Post range guards, barriers, limit of fire markers, and signals.

j. Prescribe the wear of steel helmets under certain conditions.

k. Station ambulances, emergency-type medical vehicles, and medical personnel. Ambulances, emergency-type medical vehicles, and medical personnel are not required to be at every firing range and at all practice firing. Only when flamethrowers are used is there a stated need for such precautions. In determining other occasions when medical personnel and emergency-type medical vehicles must be present during practice firing, installation commanders should consider past accidents. They should also consider demonstrated actual need for emergency medical attention at the scene. When approved by the responsible Director of Health Services, reservists who are medically qualified by their civilian occupation, but who do not possess a medical military occupational specialty (MOS) may be stationed at firing ranges when Army medical personnel are not available.

l. Take measures to protect uprange personnel.

m. Make certain personnel wear hearing protection

devices in accordance with AR 40-5, MCO 3574.2, and other applicable safety directives referring to hearing protection.

n. Authorize overhead fire over the heads of unprotected troops.

o. Investigate incidents or accidents involving weapons or ammunition with firing units.

p. Establish and maintain detailed records that—

(1) Describe the range area, including detailed permanent charts and overlays.

(2) Provide information on the types and amounts of ammunition fired into the range areas.

(3) Record known or estimated number of duds located in range impact areas.

q. Educate on-post and off-post personnel on the dangers of trespassing in impact areas and the handling of unexploded ordnance (duds).

r. Clear temporary impact areas.

s. Perform other duties and activities related to the safe operation of ranges.

2-2. Airspace safety requirements

a. Airspace referred to in this regulation is that within the United States, its possessions, and territorial waters overlying a firing range.

b. Before firing any weapon under conditions in which the maximum ordinate of fire will exceed 45 meters above ground level, the responsible commander will follow the procedures prescribed in AR 95-50. The commander will request the FAA to establish the area as a permanent or temporary restricted area or as a controlled firing area.

c. The restricted area is an area designated by the Administrator of the FAA within which an invisible hazard to aircraft in flight exists. Nonparticipating aircraft may not enter such area during the time the area is being used for the purpose designated. All hazardous activities must be within the area established. Precautions will be taken to insure the safety of aircraft operating in the airspace near the planned trajectory of all ammunition firings. An appropriate vertical danger zone (glossary) will be established for the firing operation.

d. Controlled firing area is an area established by the FAA in which ordnance firing is conducted under conditions controlled by the using agency. As a part of this responsibility, the using agency must insure that firing will cease when aircraft traverse the controlled area.

e. For safety, the number of controlled firing areas will be held to a minimum. The safety procedures to be followed when using a controlled firing area are stipulated by FAA in the agreement that established the area. These procedures will include some or all of the following safety measures. The FAA may recommend

other necessary restrictions.

(1) Conduct firing with at least 5 miles of visibility in all directions from the fire control point and a ceiling of 1,000 feet in excess of the maximum ordinate of fire.

(2) Cease firing if the projectile will enter any cloud formation.

(3) Maintain visual surveillance of the entire trajectory and target areas, plus 5 miles additional distance in all directions, before and during all firing.

(4) Provide radar surveillance (when equipment is available) of the area and beyond to detect aircraft approaching the controlled firing area. (While radar is highly desirable, it need not always be included in the restrictions since there may be unusual circumstances that would make this requirement unnecessary.)

(5) Use patrol aircraft to spot other aircraft approaching the area, when appropriate.

(6) Provide spotters who will have continuous and efficient communication with all safety officers who, in turn, are in direct communication with all firing positions.

(7) Provide a range safety officer (RSO) to insure that all firing has ceased when aircraft are approaching the area. When required, reliable communications will be established between the RSO and appropriate FAA facilities to exchange information on air traffic.

(8) Give the local flight service station a schedule of firing hours of local distribution.

f. Army airspace representatives will be located at each regional FAA office. They will help commanders prepare requirements for establishing, modifying, or rescinding restricted or controlled firing areas and presenting them to the FAA.

g. Effective dates of the establishment of restricted and controlled firing areas will be determined as follows:

(1) For restricted areas, it is the date stipulated in the designation published in the Federal Register by the Administrator, FAA.

(2) For controlled firing areas, it is the date stipulated by the assistant administrator of the regional FAA office.

h. The FAA requires complete reports at least annually to justify the use of airspace. Controlling agencies will maintain data on the use of airspace under their control in accordance with AR 95-50.

2-3. Water traffic requirements

a. Before firing over navigable waters, the installation commander will notify the US Army Corps of Engineers district or division engineer and the US Coast Guard district office of—

- (1) The type of operations to be conducted.
- (2) The water area involved.
- (3) The closed water area required.

b. Federal laws to protect traffic on navigable waters authorize the Secretary of the Army to prescribe regulations for the use and navigation of waterways endangered or likely to be endangered by firings and target practice. The US Army Corps of Engineers will have notice of the danger zone restricted area published in the Federal Register.

c. The installation commander will not authorize firing until notice of the danger zone restricted area is published in the Code of Federal Regulations (33 CFR 204) and navigation maps have been revised. The installation commander will enforce the closed water area, including radar and surface boat surveillance. No firing will start until the US Coast Guard marks the water danger zone area by the number and placement of buoys.

2-4. Notice of firing

a. Before firing involving possible hazard to the public, the commander will issue a warning order through the public news media. It will indicate the date and time of firing and describe the boundaries of the range area. The commander will enforce all closed danger areas involving possible hazard to the public.

b. When there is to be a firing, a warning order will be published and issued to the entire population of the installation at least 24 hours in advance. The place of firing, the hours it is to begin and cease each day, and the boundaries of the danger area will be given in the order.

2-5. Trespassing on range areas

Precautions will be taken to prevent—

a. All unauthorized persons from entering the surface danger zone before firing. Livestock will also be excluded unless an agreement, in writing, has been completed with the owner or owners.

b. Trespassing on target ranges during firing.

c. Handling or removal of unexploded ammunition (duds) by unauthorized personnel.

d. Entry into the impact area by all unauthorized personnel until it has been thoroughly searched and any duds found are destroyed by qualified personnel in accordance with TM 9-1300-206 and volume 1, Naval Sea Systems Command Ordnance Pamphlet 5. Access may be permitted for training purposes (e.g., maneuvers, upon completion of a visual surface clearance operation). Digging of entrenchments, foxholes, and slit trenches, however, will not be permitted.

2-6. Range guards or barriers

All normal approaches to the danger area will be covered. Range guards properly instructed in their duties will be used or appropriate barriers with signs will be posted.

2-7. Warning signals and signs

Persons approaching a firing area in use will be warned. Scarlet danger flags and, when necessary, warning signs will be displayed at appropriate points.

2-8. General limitations

a. Ranges will be located so that personnel engaged in firing activities will not be nearer than inhabited building distance to ammunition storage areas. If available land areas are inadequate, the separation distance from personnel on the firing range to ammunition storage areas may be reduced to not less than public highway distance. These distances may be determined by referring to the tables of quantity-distance in TM 9-1300-206 and volume 1, Naval Sea Systems Command Ordnance Pamphlet 5. Compute quantity distance based on the quantity and class of ammunition in the limiting magazine or storage point within the ammunition area. The limiting magazine or storage point is the one requiring the greater distance based on the quantity and class of ammunition in storage.

b. The scarlet streamer during daylight hours, substituted by blinking red lights during night hours, will be displayed from a prominent point for a range complex and at all times during firing. No firing will take place unless these conditions are met.

c. Individual vehicles, tanks, and armored personnel carriers will display a red flag when firing (para 12-10).

d. Signs warning persons of the danger from projectiles, bombs, and duds will be posted near the firing area at all times.

e. Limit of fire markers both external (outer) and internal (inner) will be emplaced to denote right and left limits of fire. Where cross-firing is to be conducted, internal limit markers will be emplaced to denote internal right or left limits of fire from specific firing positions.

f. Besides the warning signals and signs used to prevent entry to the range during firing, the boundaries of all range areas adjacent to roadways and points of entry, or along the outside limits of ricochet areas, will be posted with permanent signs. They will be placed at 200 meter intervals or less, or in a way that will insure that a person cannot enter the range without seeing at least one sign within a legible distance. The signs will emphasize the danger connected with the range area and the handling of unexploded ammunition. They will prohibit trespassing or the removal of items under penalties provided by law. The design, color, and size will conform to guidance in AR 385-30. (Hilly or wooded terrain may require more signs than would flat, open terrain.)

g. Procedures will be established to cover the turn-in of military ammunition and explosive items by unauthorized persons.

2-9. Range clearance operations

The commander responsible for range clearance operation will—

a. Review all records on an area to be cleared to determine the types of duds present and the degree of contamination.

b. Determine the type of clearance to be done.

c. Request the supporting explosive ordnance disposal (EOD) element to scout the area to confirm the information in the records. This will help in the preparation of a detailed clearance plan.

d. Prepare a detailed plan of operation. It will include—

(1) Number of EOD qualified personnel needed to supervise the operation.

(2) Number of other personnel needed (e.g., searchers, supervisors, and drivers).

(3) Amount and type of equipment needed (such as vehicles and engineer equipment).

(4) Dates and time to conduct the clearance.

(5) Funding for the clearance operation.

(6) Administration and logistical support.

(7) Medical personnel and emergency-type medical vehicles needed.

(8) Safety training for all searchers, markers, and supervisory personnel. Training will be conducted before the start of an operation and as required during operations. All personnel who will participate in range clearance will view Army Training Film 9-6153.

e. Prepare after-action reports, including the information required by AR 405-90, or applicable US Navy or Marine Corps directives, as a permanent part of the range records.

2-10. Education

a. Installation commanders having range impact areas will place special emphasis on aggressive educational programs. All personnel must be properly cautioned on the dangers of dud ammunition and other items of unexploded ordnance. In this regard, maximum use should be made of the US Army Forces Command (FORSCOM) EOD personnel and guidance in FM 9-15.

b. Military family members will be instructed that ranges are off limits and will be cautioned about the hazards.

c. The local news media will be used periodically to warn the nearby communities of the hazards in trespassing on range areas and in handling unexploded ammunition.

d. A program will be established to educate school children, both on and off the installation, on range hazards.

e. Military parents, children, and other personnel will be instructed in the local procedures that provide

15 October 1983

for turning in or reporting of unauthorized Government ammunition or ordnance to military authorities.

2-11. Police of ranges

The collection of spent brass is not required when am-

munition is expended from aircraft-mounted weapons over extended terrain or otherwise inaccessible areas (e.g., impact areas containing high explosive (HE) dud ammunition.)

Chapter 3 Ammunition

3-1. Ammunition positioning and issuance

a. Locate all ammunition at firing sites outside the blackblast area (when applicable) for the weapons involved. Store ammunition at a position that will minimize the potential for ignition, explosion, or rapid burning.

b. Issue ammunition to firing units immediately before scheduled training exercises. Distribute small arms ammunition to troops only when they are on-the-ready line or firing line.

c. Cover all ammunition to protect it from the elements and direct rays of the sun. Provide air circulation between the ammunition and cover for proper ventilation.

d. Limit the unpackaging of ammunition at the firing line to the minimum number of rounds needed for efficient firing of the exercise. Retain packaging material, propelling increments, and fuzes until firing is complete. Army and Marine Corps units will not burn wooden containers or indiscriminately fire ammunition to preclude return to a storage site.

3-2. Ammunition qualification or restriction

a. The use of nonstandard items is prohibited unless specifically approved by the Commanding General (CG), DARCOM, or the Commandant of the Marine Corps (Code LMG); CG, US Army Combat Development Experimentation Command, Fort Ord, CA; CG, US Army John F. Kennedy Center for Special Warfare, Fort Bragg, NC; and the Commanding Officer, 10th Special Forces Group, Fort Devens, MA. The commanding officer of special forces groups may also approve the use of nonstandard items of explosives when necessary to their operations of special forces training. Inform the Commander US Army Armament Material Readiness Command (ARRCOM) (CDR ARRCOM Rock Island IL//DRSAR-QAS), by message, of the approval for nonstandard item.

b. Small arms ammunition (SAA) with loss of lot identity (unknown lots) that have been inspected and classified according to HQ ARRCOM criteria will be assigned priority of issue for training. Training use is authorized for hand weapons (rifle, pistol, shotgun), ground and vehicle mounted machinegun, M60 series (7.62mm), and M2/M3 series (cal .50). These munitions are prohibited from use in overhead fire and qualification exercises while firing the M73, M219, and M240 series (7.62mm) and M85 series (cal .50) machinegun.

c. Any alteration of loaded ammunition (e.g., in-

creasing the amount of propellant) is prohibited. Exceptions may be made by CG, DARCOM, or the Commandant of the Marine Corps (Code LMG) or the commandant's authorized representative. Alterations will be under the supervision of a commissioned officer or qualified civilians from DARCOM. Assembly of explosive components into inert rounds is also prohibited, unless CG, DARCOM, or Commandant USMC (Code LMG) or the commandant's authorized representative has approved.

d. All ammunition for demonstrations, training, or similar activities will be used for the purpose for which it was manufactured. Any attempt to use ammunition in an unorthodox manner or to purposely attempt to make it malfunction, such as by jamming VT fuzes with signal equipment, is prohibited. Exceptions may be granted for special tests and demonstrations when plans are reviewed and approved, in writing, by CG, DARCOM, or Commandant, USMC (Code LMG).

e. Those who control ammunition for a unit must know the inherent hazards of the specific type of ammunition and the proper identification markings and color codes. Firing restrictions and lot suspensions for the specific ammunition involved will be recorded in the unit (not applicable to Marine Corps units) ammunition property book (records).

f. The officer in charge (OIC) and RSO will have on hand and be familiar with, current field and technical manuals for the weapons or weapon system being fired. These manuals provide limitations and warnings for type of ammunition being fired.

g. The following rounds will not be fired unless the firing vehicle is "buttoned up" and no unprotected observers are near the firing vehicle:

(1) 152mm SHILLELAGH missile (driver's hatch only)

(2) 165mm Gun (CEV) when range to impact is less than 1,000 meters.

h. The following rounds will not be fired over the heads of unprotected troops:

(1) Cartridge, 105mm, APDS-T, M392 (L36A1)M392A2.

(2) Cartridge, 105mm, TPDS-T, M724, M724A1.

(3) Cartridge, 105mm, APDS-T, M728.

(4) Cartridge, 105mm, APFSDS-T, M735.

(5) Cartridge, 105mm, APFSDS-T, XM774.

(6) Cartridge, 105mm, German, HVAPDS-T, DM 1381.

(7) 152mm SHILLELAGH missile.

(8) 165mm Gun (CEV).

(9) New production discarding sabot ammunition.

i. Ammunition intended for any exercise that requires overhead fire must be approved for such use. Re-

quests for lot clearance will be sent to Commander, ARRCOM, ATTN: DRSAR-QAS, Rock Island, IL 61299, by letter or message, in a time frame consistent with training requirements. Only those lots to be used in overhead fire should be included in the request. Emergency requests will be honored by telephone. Confirmation will follow by message or letter. Receipt of a restriction or suspension message from ARRCOM on any lot previously cleared automatically cancels overhead fire certification. The requisitioner must identify requests for ammunition that require clearance for overhead fire use. Requisitions processed by the national inventory control point (NICP) on a materiel release order (MRO) with project code "YTT" in card columns 57-59 of DD Form 1348 (DOD Single Line Item Requisition System Document Manual), or equivalent, indicate lots require clearance. Internal control procedures will be established at depots, plants, arsenals, and supply points to make certain that requisitions for ammunition to be used for overhead fire are filled with ammunition that has been cleared and approved for overhead fire.

(1) Ammunition lots determined, after formal requests, to be satisfactory for overhead fire will be listed in appendix C, TB 9-1300-385-1.

(2) Ammunition lots determined not to be suitable for overhead fire use will be listed in appendix D, TB 9-1300-385-1. Lots of ammunition currently listed in TB 9-1300-385-1 and TB 9-1300-385-2 with restrictions "not to be used for overhead fire" will be deleted from current editions of these manuals and appear only in appendix D of TB 9-1300-385-1. Marine Corps activities will use the reclassification system in NAVSEA TWO 24-AA-ORD-010 to determine ammunition serviceability.

j. Only lots of artillery ammunition that have been cleared and are not suspended or restricted by TB 9-1300-385-1 or TB 9-1300-385-2 will be used in training exercises requiring overhead fire and close support of ground troops by overhead or flanking fire and overhead fire attack courses. Each lot of ammunition used in these exercises will be fired for adjustment before firing over the heads of troops in training. When overhead firing exercises are conducted under waived conditions in accordance with paragraph 1-6, functional clearance, lot by lot, will be obtained. Request for such clearances will include a statement describing the waived condition.

3-3. Suspension of ammunition and explosives involved in malfunctions

a. When any round or item of ammunition or explosives (or their components) has malfunctioned, further use of rounds or items will be suspended. Appropriate action will be taken as required by AR 75-1 or MCO

8025.1. Firing suspensions and restrictions are published in TB 9-1300-385-1, TB 9-1300-385-2, NAVSEA TWO 24-AA-ORD-010, and appropriate technical manuals.

b. If a malfunction is suspected, firing of the lot will cease immediately and further use of all weapons involved will be discontinued. All materiel involved in the incident will be secured undisturbed until designated personnel investigate the incident and determine appropriate disposition of the materiel. Marine Corps units will also report defective ammunition in accordance with MCO 8025.1.

3-4. Disposition of materiel involved in malfunctions

a. Materiel involved in malfunctions or accidents and any evidence, such as components or fragments of the weapon or ammunition, will be carefully preserved until disposition is directed by ARRCOM (DRSAR-MAD).

(1) If, in the opinion of the local ammunition officer or quality assurance specialist (ammunition surveillance), the preservation or shipment of the materiel may endanger life or property, local disposition instructions may be directed. Components, fragments, and residue will be secured and retained for 90 days after the report of a malfunction. When disposition instructions are not received within 90 days, local disposition is authorized. If the cause of the malfunction is doubtful or undetermined, all affected materiel will be held until disposition instructions are furnished by Commander, ARRCOM.

(2) When shipment of materiel involved in, or affected by, a malfunction is directed by Commander, ARRCOM, copies of the shipping document will be promptly sent to the consignee and Commander, ARRCOM, ATTN: DRSAR-MAD, as evidence that the materiel has been shipped. To insure correct identification, the shipping document will contain appropriate references to the report of malfunction. When shipped by registered mail, a message will be dispatched, indicating registry number, date of shipment, shipper, and destination. Marine Corps units will comply with MCO 8025.1.

b. For the destruction of ammunition and explosives, see TM 9-1300-206. Assistance from EOD personnel is recommended if such services are available. A commissioned officer, noncommissioned officer (grade E6 or above), or Army civilian employee trained in ammunition and explosive operations will supervise the destruction of ammunition or explosives and will be responsible for compliance with TM 9-1300-206. Marine Corps explosive ordnance and demolition personnel must supervise the destruction of ammunition and explosives at Marine Corps activities.

Chapter 4 Firing

4-1. General

Persons in charge of, or using ranges, maneuver areas, and training facilities are responsible for compliance with the safety requirements of this regulation and with applicable TMs and FMs.

4-2. Range safety

a. The installation commander is responsible for overall range safety in accordance with chapter 2.

b. The commander of using units will—

(1) Insure that all personnel are familiar with local range procedures and safety requirements.

(2) Designate an officer in charge (OIC) (commissioned officer, warrant officer (WO), noncommissioned officer (NCO)) for each firing point or range as specified in table 4-1 to be responsible for the safe conduct of firing and proper use of facilities.

(3) Comply with installation procedures for certifying individuals who will perform the duties of OIC, WOIC, NCOIC; range safety officer; and section chief to insure they are—

(*a*) Competent and properly instructed in the performance of their duties.

(*b*) Knowledgeable of the weapons systems for which they are responsible.

(4) Coordinate plans for firing exercises and maneuvers with range control.

c. The officer in charge will—

(1) Be responsible for the overall safe conduct of training and proper use of facilities.

(2) Be present at the unit firing area.

(3) Be a commissioned, warrant, or senior noncommissioned officer (table 4-1) from the training or firing units' chain of command and weapon system qualified as designated by the commander.

(4) Appoint an RSO when required (table 4-1) to help perform safety responsibilities. (Additional assistant range safety officers (ARSO) may be appointed as required.

(5) Determine when it is safe to fire.

(6) Supervise the procedures for misfires, hangfires, and cookoffs.

(7) Insure required communications are established and maintained.

d. The range safety officer will—

(1) Be responsible for the final determination before firing that—

(*a*) Weapons are properly positioned.

(*b*) Only authorized ammunition, to include

proper charge, fuze, and fuze settings, are used.

(*c*) Firing settings and weapons are within prescribed safety limits and verified.

(*d*) Appropriate safety measures are taken and the surface danger zone is clear of personnel. (This includes closing of barriers denying entry into the impact area and the posting of road guards.)

(*e*) Proper hearing protection is worn by personnel engaged in firing.

(2) Order an immediate cease fire or check fire when any unsafe condition is observed.

(3) On completion of firing, verify weapons are clear to the OIC and range control and record duds and their approximate location.

4-3. Who may be an OIC or RSO

a. A commissioned, warrant, or noncommissioned officer (table 4-1) from the training or firing unit chain of command may be an OIC or RSO.

(1) Noncommissioned officers serving as range safety noncommissioned officers (RSNCOs) will normally be in the grade of E6 or above. NCOs in the grade of E5 may serve as RSNCOs if they are filling E6 positions.

(2) The RSO on combined arms live fire exercises (CALFEX) will be of the grade prescribed in table-4 based on the complexity of the exercise and number of participants (i.e., squad, section, platoon, company, troop, squadron, battalion and larger).

b. Personnel detailed as RSO, range safety warrant officer (RSWO), or RSNCO must—

(1) Have satisfactorily completed a standard program of instruction in the duties of RSO developed by the battalion to which they are assigned.

(2) Be qualified and knowledgeable in the weapons systems involved and the RSO duties required.

c. Civilians may act as OIC and RSO of firing ranges if they are qualified and approved to perform such duties by the installation RCO (e.g., weapons testing and competitive shooting).

4-4. Firing conditions

a. Firing by other US military services may be conducted on Army or Marine Corps ranges in accordance with this regulation.

b. Firing of weapons systems not provided for in this regulation will be in accordance with the appropriate Service's safety requirements.

c. Firing by other nations on Army or Marine Corps installation (owned, operated, controlled) ranges requires approval by the MACOM Army or Marine Corps commander.

d. Ammunition will not be fired over ammunition

storage areas, public traffic routes, or other nonrelated inhabited areas. Firing will be directed away from ammunition storage areas, if possible.

e. Data on the type of dud-producing HE ammunition fired into the impact area and the number of duds and their approximate location will be recorded by firing units. The installation commander will maintain these data as permanent records.

4-5. Duties of the OIC

a. *Prior to firing.* The OIC will insure that—

- (1) The correct range or firing position is occupied.
- (2) The impact area is clear of unauthorized personnel and safety measures directed by the installation commander have been taken (use of barriers to deny access into the impact area and posting of road guards).
- (3) Required communications are established and operative.
- (4) Only authorized ammunition, including proper charges and fuzes, are used.
- (5) Ammunition to be fired is within prescribed safe temperature limits.
- (6) All firing precautions (including bore sighting) have been taken.
- (7) Clearance to fire has been obtained from range control.

b. *During firing.* The OIC will insure that—

- (1) Personnel do not move to or leave from the firing line on small-arms ranges or crew-served-weapons ranges without the permission of the OIC or RSO.
- (2) Materiel is not removed from the firing line without permission of the OIC or RSO.
- (3) The surface danger zone is monitored to insure it remains clear.
- (4) Impacts are observed to insure projectiles land within the prescribed impact areas.
- (5) Misfires are removed from the weapon only on command of the OIC in accordance with procedures established for the weapon.
- (6) Weapons are cleared and checked during temporary suspensions of firing.
- (7) Records are maintained on the type of ammunition fired, the number of rounds fired, the number of duds and their approximate location.
- (8) Firing is stopped promptly when any unsafe act is observed or reported.

c. *After firing.* The OIC will insure that—

- (1) All weapons are cleared. (Tank commanders and section chiefs will insure that their weapons are cleared on completion of firing.)
- (2) The number of duds and their approximate location are reported in accordance with local procedures.
- (3) Firing status of ranges or vehicles is properly designated by flags or lights.

d. *Misfires, hangfires, and cookoffs.*

(1) The OIC is responsible for supervising the handling and disposition of misfires, hangfires, and cookoffs.

(2) Procedures for each of these malfunctions depend on the type of weapon and ammunition. The nature of each malfunction and proper handling procedures must be understood to avoid injury to personnel or property damage.

(3) Pertinent technical and field manuals will be used to determine proper handling procedures for each malfunction.

(4) These types of malfunctions will be reported in accordance with AR 75-1. If they result in injury or property damage, report in accordance with AR 385-40.

4-6. Special firing considerations

a. *Overhead fire.*

(1) Fire over protected and unprotected troops will be as prescribed in chapter 16.

(2) Ammunition authorized for overhead fire will be approved in accordance with chapter 3.

b. *Records.* Data required by paragraph 2-1p will be recorded for each firing of dud-producing ammunition. The installation RCO will maintain these records permanently.

c. *Improved conventional munitions (ICM).* These munitions must be fired into a dedicated impact area where troops are not permitted to maneuver. The area should be relatively flat and free of heavy vegetation. Impact areas used for ICM firings are considered dangerously contaminated. Personnel access to ICM impact areas is limited to qualified EOD personnel or personnel escorted by qualified EOD personnel. Dedicated ICM impact areas must be cleared of duds as prescribed by the installation commander.

d. *Conventional ammunition impact areas.* Conventional ammunition impact areas to which access is to be granted (e.g., hunting and forestry) must be surface cleared of dud ammunition on a regularly scheduled basis before access is permitted.

e. *Temporary or conventional ammunition impact areas.* Temporary or conventional ammunition impact areas to be used for training (e.g., maneuvers or other purposes where personnel will be in the impact area) must be surface cleared before such use. Cleared areas that become contaminated during a live fire exercise are not required to be cleared again until the live fire exercise has been completed. Personnel who must enter a contaminated live fire exercise area will be briefed on the hazards of dud ammunition.

4-7. Destruction of dud ammunition

Destruction of dud ammunition will be in accordance with TM 9-1300-206 or volume 1, Naval Sea Systems Command Ordnance Pamphlet 5. Destruction of duds

will be done only by or under the supervision of EOD personnel who are fully aware of the hazards.

4-8. Other range usage

a. Use of ranges by Rod and Gun Club members are subject to the same requirements as Active Army personnel. A bilateral agreement should be in effect between the installation and the club. It should spell out rights, liabilities, procedures, and regulatory requirements and responsibilities.

b. Use of ranges by police or other civic organizations is sanctioned. All ranges constructed, wholly or in part, with funds provided by Congress will be open for use by clubs, schools, colleges, and other responsible organizations, under regulations prescribed by the controlling authorities. Bilateral agreement should also be developed as discussed above. Completion of some type of National Rifle Association approved pistol and rifle instructor courses, or installation equivalent, is mandatory. Those who satisfactorily complete these courses should be competent to perform OIC or RSO duties on small arms ranges.

c. The controlling commander may withdraw privileges of using the range and installation from any person or organization that willfully disobeys rules and regulations prescribed for the range, or from any person whose conduct on the range or installation warrants such action. Commanders may refuse the use of the range to any individual whose knowledge of the principles of marksmanship is deficient to the degree of posing a safety hazard.

4-9. Control of spectators and military family members (MFM) on firing ranges

a. The only time an MFM (minor) will be permitted on the firing line is under competent adult supervision and when engaged in an approved course of marksmanship training (e.g., junior ROTC training). These MFM must obey all firing and safety regulations (including the wear of personnel protective hearing devices). Failure to comply with these rules will result in immediate removal from the firing line and a denial of the right to take part in live weapons firing. All other MFM not actually engaged in firing or coaching must remain behind the firing lines.

b. Spectators frequently come to small arms demonstrations, training courses, competitions, and other types of firing. Normally they must stay behind the firing line or firing activity. There may be exceptions when experienced personnel are demonstrating weapons or where several persons in an inspection party are observing firing activities. In any case, the firing line and the area authorized for spectators will be well defined with the proper signs and markings. Spectators (as part of an inspection team or official observers), even though required to be on the firing line as an exception to the foregoing policy, must remain behind or to the side of shooters. They must also stay to the rear of the muzzle but away from the recoil and back-blast area of all weapons on the firing line. OIC and RSO or ARSO are responsible for range safety and the control of all spectators. Any spectator who compromises safety or distracts shooters or range personnel will be removed from the range.

Table 4-1
Officer in charge and range safety officer requirements

Weapon system	Officer in charge ¹			Range safety ¹		
	OFF	WO	NCO	OFF	WO	NCO
Practice hand grenade and rifle grenades; subcaliber training devices; LASER ranges; firing devices; simulators, trip flares; small arms and machineguns	X	X	E6	None required except for LASER ranges ²		
Chemical agents and smoke	X ³	X	X	None required ³		
Aerial gunnery, air defense weapons; flamethrowers; live grenades (hand and rifle); mines and demolitions; mortar; recoilless weapons; rockets; guided missiles (chap 12), tank cannon	X	X	E7	X	X	E6
Artillery	X ⁴	X	E7	X ⁵	X	E6
Live fire exercises using organic weapons, squad through company, battery, troop	X	X	E7	X	X	E6
Combined arms live fire exercises using outside fire support: Squad-section-platoon Company, battery, troop, battalion, squadron or larger	X X ⁶	X	E7	X X	X	E6

Notes:

1. Civilians may act as OIC or RSO (para 4-3c).
2. Complexity of exercise, number of participants, and physical separation of OIC from firing point may indicate need for RSO.
3. When nuclear, biological, chemical (NBC) training is being conducted, OIC must be NBC qualified. If an RSO is used, he or she must also be NBC qualified.
4. Use of E7s and above to act as OICs of artillery firing ranges is authorized only when approved by the installation commander.
5. Duties of safety officer are normally performed by the battery executive officer.
6. OIC will be a field grade officer for battalion and larger size units.

Chapter 5 Targets

5-1. Moving targets

a. Firing at manned vehicles is not authorized unless the OIC is certain that no additional hazard exists for the crew of the vehicle due to the projectile being fired. The hazards to be considered are primary and secondary fragmentation, noise, toxic byproducts, and fire. Manned target vehicles designed by DARCOM will not be fired at with any weapon different than those for which the vehicle was designed to defeat.

b. No weapon will be fired when it is pointing at or ahead of a towing vehicle, aircraft, or vessel.

c. Communication will be maintained between the towing vehicle, vessel, or aircraft and the firing position.

d. For firing at night, the towing vehicle, aircraft, or vessel will carry lights that indicate its position to the range RSO or OIC. Firing on the target is permitted only when both the target and the towing vehicle, aircraft, or vessel lights are visible from the firing position.

5-2. Waterborne targets

a. The field of fire will be observed to insure that the range is clear during firing. In some cases observation may be satisfactory from the ground alone; in others, observation from the water and from the air may be necessary. Effective means of communication between safety observers and firing position will be provided. The observers must be notified immediately when firing is to commence and the firing position must be notified immediately when the field of fire is unsafe. In addition, individual personnel are directly responsible for insuring that the range is clear before firing.

b. In firing at a water-towed target by manned vessels, the following precautions will be observed:

(1) Firing is prohibited when the angle between the path of target and the line joining the target and battery is less than 40 degrees (712 mils).

(2) When direction is given to the piece by aiming the sight at the target, the length of towline will be at least 3 percent of the range from the firing position to

the target. In no case will it be less than 275 meters.

(3) When the piece is aimed by an azimuth circle or by directing the sight at an aiming point other than the target, the length of the towline will be at least 3 percent of the range from the firing position to the target. In no case will it be less than 460 meters. When firing at non-manned radio controlled targets—

(*a*) Control aerial targets from target control stations located outside the surface danger zone.

(*b*) Clearly define the right and left safety limits of each weapon and any restricted areas within the field of fire. For a mobile gun, have markers placed a short distance in front of the guns and visible to the gun pointing safety checker. For a fixed gun, mark these limits on the azimuth circle. The RSO will restrict the firing of the weapon to safe areas within the field of fire.

c. The RSO will be responsible for determining that the field of fire is clear before firing.

d. The provisions of paragraph 5-1*b*, *c*, and *d* are not applicable when firing at remote controlled targets.

5-3. Ballistic aerial target system (BATS)

a. The BATS is a free-flight, rocket-propelled system used mainly by air defense units firing ground-positioned weapon systems such as VULCAN, REDEYE, CHAPPARRAL, and STINGER.

b. Propulsion for the BATS is provided by one of the following methods:

(1) Assembling two, three, four, or five standard 2.75-inch folding fin aerial rockets (FFAR) for boost and a sustainer motor using two MXU-4A/A jet engine starter cartridges.

(2) Assembling three standard FFARs for boost with no propellant or ballast placed in the sustainer motor (BOOST-COAST configuration).

c. The surface danger zone for the BATS is shown in figure 5-1. Maximum range distances are shown in table 5-1.

d. For launches in surface winds greater than 30 knots, the BOOST-COAST configuration should be used in place of the two-booster, sustainer configuration.

Table 5-1
Ballistic aerial target system range distances

<i>Configuration</i>	<i>Maximum range (meters)</i>
Boost, coast	3332
2 booster, sustainer	4526
3 booster, sustainer	6067
4 booster, sustainer	7135
5 booster, sustainer	7998

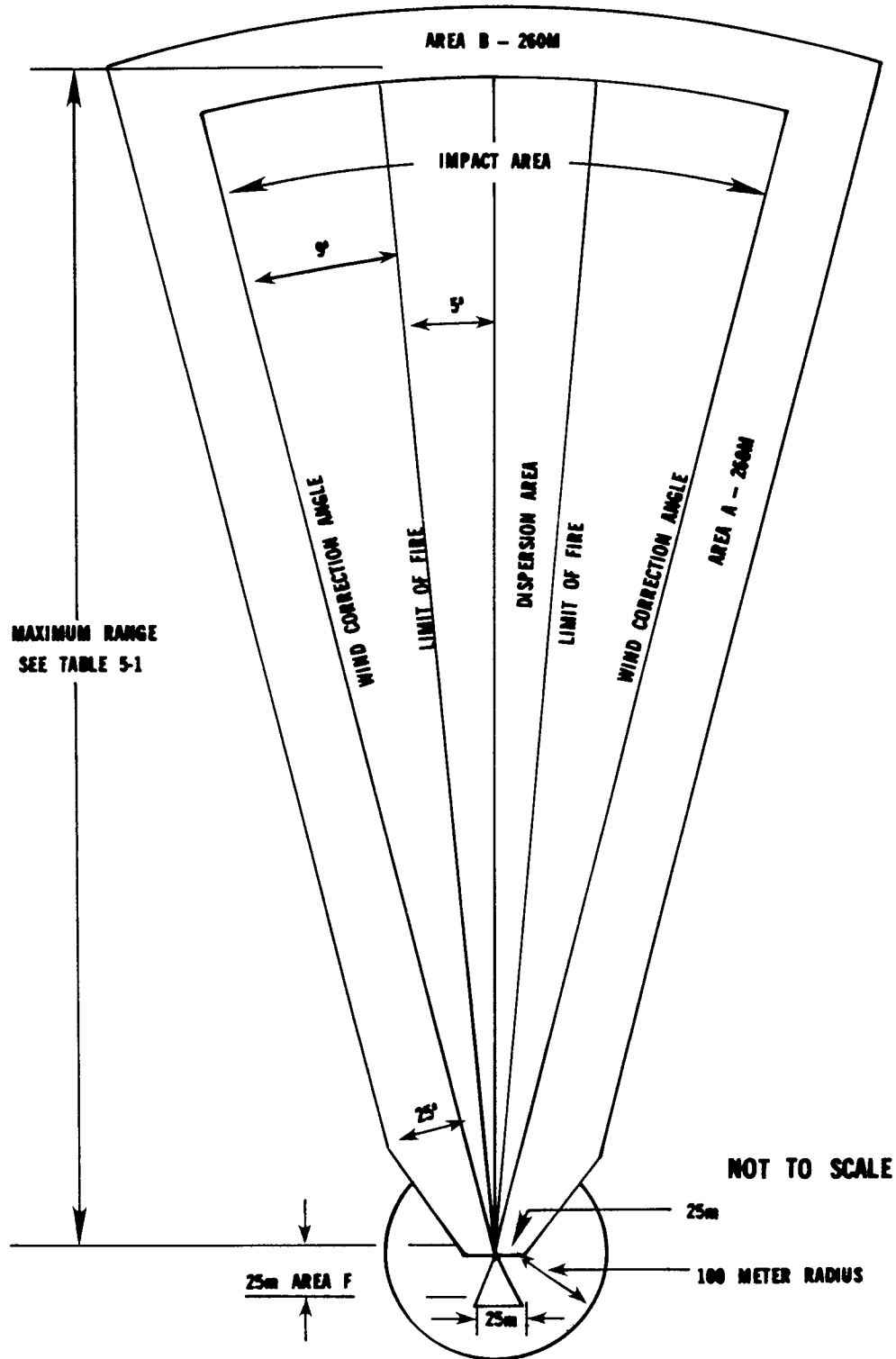


Figure 5-1. Surface danger zone for firing the ballistic aerial target systems

Chapter 6

Small Arms and Machineguns

6-1. Small arms and machinegun fire

a. Firing small arms and machineguns against ground targets will conform to the instructions below.

b. Figure 6-1 shows the surface danger zone that will be used when firing from a single firing position on a single line of fire. When the nature or extent of training requires multiple firing positions, the figure will be bisected along the line of fire and the proper firing sector will be inserted. (See fig 6-2.)

(1) *Impact area.* The impact area will be established by projecting an angle corresponding to 5 degrees in deflection (dispersion) on both sides of the gun-target-line (line of fire).

(2) *Ricochet area.* The ricochet area is an angle in deflection of 5 degrees beyond both sides of the impact area. This area will provide adequate distances to contain ricochets under soft, dry, loamy soil. Soil containing rocks and firing on hard targets will require larger distances.

(3) *Area A.* See surface danger zone (Area A) in the glossary. For dimension, see table 6-1.

6-2. Overhead fire

Overhead fire with small arms ammunition may be conducted as described in paragraph 16-4. Personnel must be provided adequate cover. Table 6-2 shows the thickness of various materials needed to positively protect against individual bullet impact. The material thickness will not provide protection against continued burst firing.

6-3. Safety from ricochets

Area A should be widened as necessary to provide safety from lateral ricochets. Local authorities determine this by actual examining terrain and observing tracer firing.

6-4. Shotgun ranges

a. International standard skeet and trap range plans may be found in the Folio of Standard Drawings, EF 1110-1-6; Outdoor Sports Facilities, published by the Office of the Chief of Engineers; WASH DC 2314; or NAVFAC P-272, published by Naval Facilities Engineering Command.

b. Training ranges used for 12-gauge weapons firing cartridges loaded with No. 00 buckshot will be in accordance with surface danger zone requirements established in table 6-1 and figure 6-3.

Table 6-1. Small arms and machineguns (See figs 6-1, 6-2, and 6-3.)

Dimension of areas and range in meters		
Caliber	A	Maximum Range
Cal. 22 long rifle.....	100	1400
5.56 rifle.....Ball, M193....	100	3100
7.62 rifle & machinegun, Ball M80.....	100	4100
Match, M118.....	100	4800
Cal. 30 rifle & machinegun, Ball, M2.....	100	3100
AP. M2.....	100	4400
Cal. 30 Carbine.....	100	2300
Cal. 45 open range (no back stop)		
Pistol.....	100	1300
Submachinegun.....	100	1400
Cal. 50 machinegun.....Ball, M33.....	100	6500
AP, M2.....	100	6100
Shotgun, 12 GA. riot		
(00 buckshot)	100	600
Cal. 38 Revolver.....Ball, M41.....	100	1600
Ball, PGU-12/8	100	1900

Table 6-2. Thickness of material for positive protection against caliber ammunition listed (See para 6-2.)

Nature of cover	Thickness in inches		
	5.56mm	7.62mm & Cal .30	Cal .50
Concrete (5000 psi).....	.5	7	12
Broken stone.....	14	20	30
Dry sand.....	16	24	32
Wet sand.....	25	36	48
Logs wired together (oak). ...	28	40	56
Earth packed or tampered.....	32	48	60
Undistributed compact			
earth.....	35	52	66
Earth freshly turned.....	38	56	72
Plastic clay.....	44	65	100

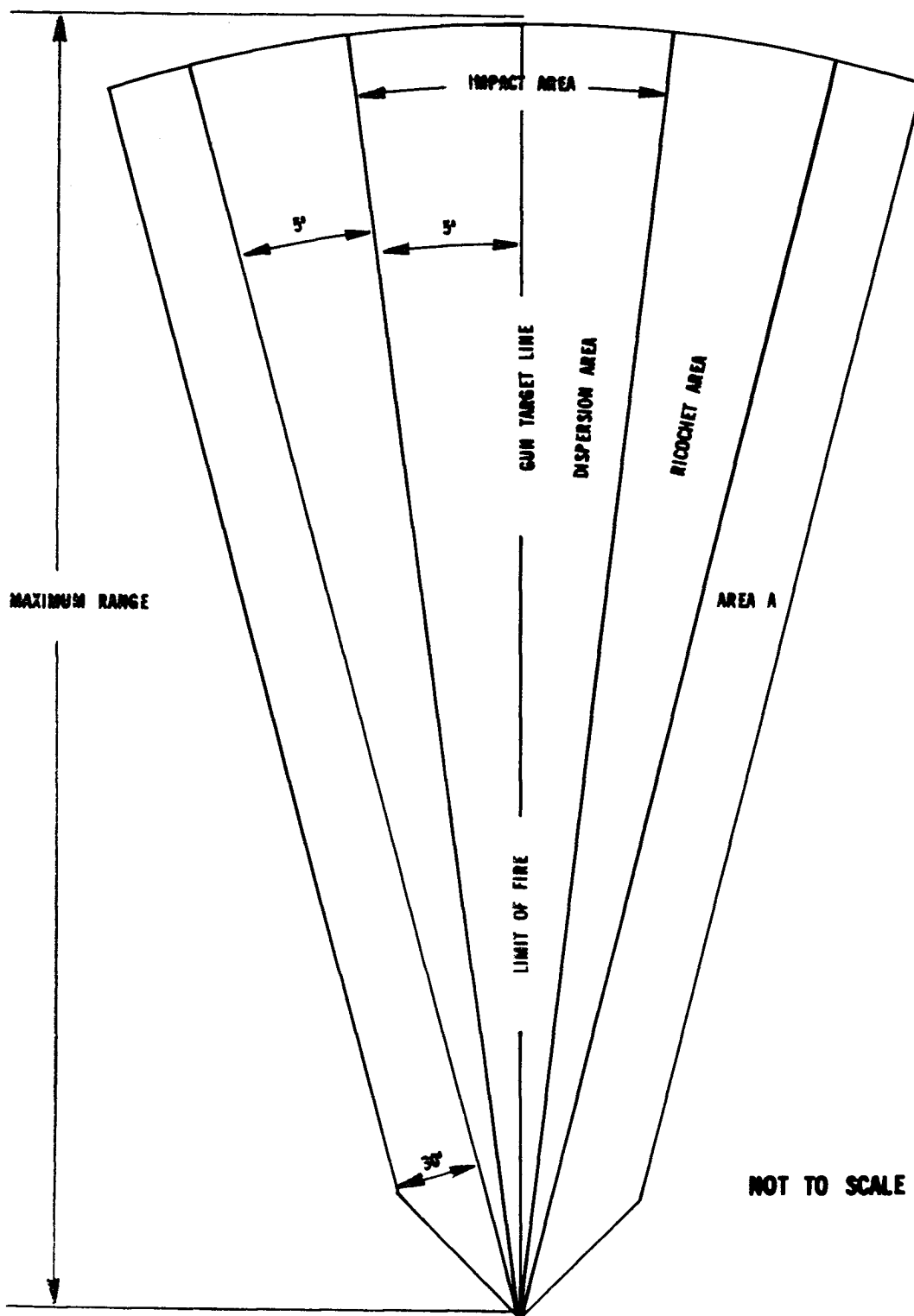


Figure 6-1. Surface danger zone for single small arms weapons firing at fixed ground targets

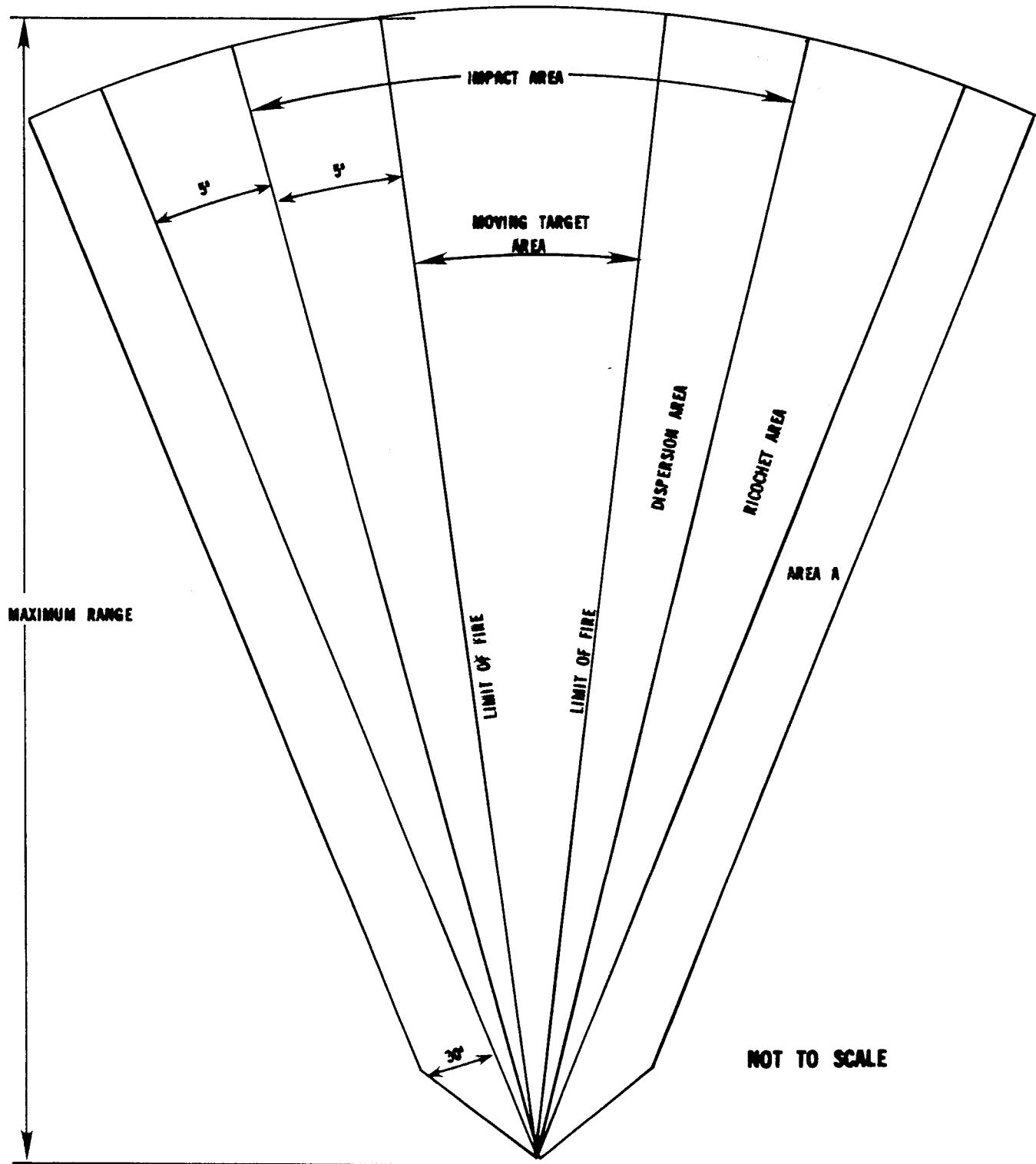


Figure 6-2. Surface danger zone for single small arms weapons firing at moving ground targets

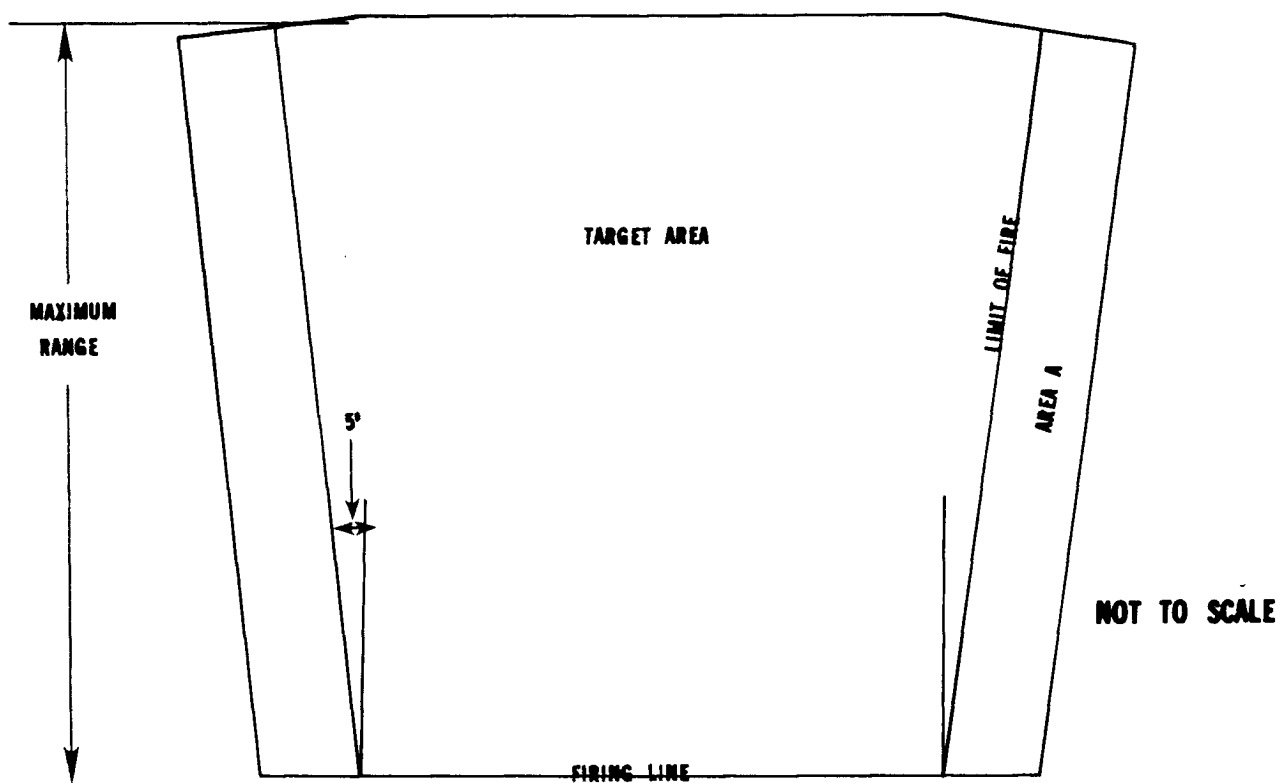


Figure 6-3. Surface danger zone for firing 12 GA. riot guns using cartridges loaded with 00 buckshot or smaller

Chapter 7

Hand Grenades and Rifle Grenades

7-1. Hand grenades (fragmentation and offensive)

a. For instructional and training purposes, fragmentation and offensive hand grenades will be thrown from a trench or barrier equivalent to a screen of sandbags 0.5 meters (20 inches) thick. When barriers (throwing bays) are used for protection, they will be built to a minimum height of 1.5 meters (5 feet) and wide enough to accommodate one thrower and one safety NCO. For other dimensions, see FM 23-30. Throwing bays will be separated from adjacent bays by a distance of 20 meters (about 66 feet). This is not necessary when bays are separated from one another by a physical barrier (i.e., earthen berm, concrete wall, or wooden revetment long and high enough to attenuate high-velocity, low-angle grenade fragments).

b. Those handling or throwing casualty-producing hand grenades or who are within the danger area (150 meters) will wear steel helmets.

c. The safety clip used on certain fragmentation and practice grenades must be removed before the safety pin is removed when attached to the grenade. Once the safety pin has been pulled, the grenade will, on command, be thrown. Do not attempt to reinsert the safety pin or tape the handle.

d. Before live grenade training begins, all personnel must be knowledgeable of and proficient in the safety precautions for handling, throwing, and disposing of live grenades. Also, they must have successfully completed practice grenade training.

e. At least a 30 minute waiting period will be observed before an HE-loaded grenade dud is approached. During training, the throwing of live grenades in any bay within the uninterrupted fragmentation radius of the dud grenade will stop. Dud grenades will be destroyed in place only by authorized EOD personnel.

7-2. Grenade, hand chemical

a. *Burning type.* Burning-type grenades (riot control, smoke, and incendiary) are ignited by pulling the safety pin and releasing the safety lever. After the safety pin has been pulled, the grenade will be thrown before the safety lever is released. Once the safety lever is released there is no way to stop the grenade from functioning. When the burning-type grenade is fired in place, the firer will keep his face turned away from the grenade and, after releasing the safety lever, will quickly move away at least 10 meters to avoid the incendiary particles and fumes emitted during the burning. Chemical gre-

nades must not be held in the hand after the safety lever is released. The incendiary hand grenade may be taped or tied in place if the incendiary effect is desired at an exact location. In this case, safety pins will not be pulled from the grenade until the desired time of functioning. Remote firing pin removal is preferred. All burning-type grenades produce great heat. Extreme caution will be taken in their use to prevent accidental fires. Burning-type grenades will not be used in an enclosed space (such as tunnels into which personnel will later enter) unless the space is first thoroughly ventilated. The oxygen consumed must be replaced and the fumes removed. Specific fuse burning delay time and functioning characteristics are in TM 9-1330-200.

b. Fragmentation-type and bursting-type grenades.

(1) Since fragmentation HE-loaded-type grenades contain explosive charges that detonate after a short time 4 to 5 seconds, every precaution will be taken to prevent injuries from flying fragments (danger radius is 150 meters).

(2) During demonstrations, fragmentation-type grenades will be thrown from a barricaded position so that they burst not less than 150 meters from the nearest unprotected person.

(3) Burning particles of white phosphorous are frequently projected from the M15 and M34 grenades to a distance of 35 to 40 meters from the bursting point. These particles cause serious, painful, slow-healing burns. First aid measures are covered in FM 21-11 and FM 21-41. During training, the M15 and M34 grenades will be thrown only on the standard live grenade practice course prescribed in FM 23-30.

c. *Bursting-type, riot-control grenade.* Before conducting training exercises with the M25 bursting-type, riot-control grenade, personnel will be instructed on the proper method of holding the grenade. The safety pin must be kept depressed until the grenade is thrown. M25-type grenades will not be thrown closer than 25 meters from the nearest unprotected person.

7-3. Rifle grenades

a. Live rifle grenades will be fired from behind a protective barrier equivalent to a screen of sandbags 0.5 meters (20 inches) thick or reinforced concrete walls .16 meters (6 inches) thick.

b. Danger area radius for the rifle grenade is 200 meters.

c. The OIC will insure that only the authorized grenade cartridge is used to fire the rifle grenade.

7-4. 40mm grenade launcher M79 and M203; MK19, 40mm MG (grenade)

a. Personnel will be instructed in the proper use of

and safety precautions for the launcher before firing with live rounds.

b. The hazardous fragmentation radius for the HE cartridge is 130 meters from the point of detonation.

c. When HE grenades are fired into a *cleared area*, dud grenades will be accounted for and cleared from the range after each firing exercise by EOD personnel. When HE grenade duds are fired into an area containing foliage and duds cannot be accounted for, the impact area will not be used for any purpose other than a dedicated impact area. Where a dedicated impact area is used, it will be fenced and posted to keep out unauthorized personnel.

d. Even though the 40mm grenade launchers M79 and M203 are designed to prevent accidental chambering of 40mm high velocity cartridges, the OIC will insure that only low velocity authorized rounds are used. The M383, M384, M385HV, or M430 rounds will not be fired.

7-5. Surface danger zones

a. For hand grenades, see figure 7-1.

b. For 40mm grenade launchers M79 and M203, see figure 7-2. The surface danger zone represents three firing lanes. Additional firing positions may be added if a minimum separation of 6 meters is maintained between positions.

c. For MK19, 40mm machine gun (MG), see figure 7-2. Maximum range (distance X) is 2200m and will not be reduced.

d. For rifle grenades, see figure 7-3.

(1) The surface danger zone represents one firing lane for HE-loaded grenades. Additional firing positions may be added if a minimum separation of 25 meters is maintained between each position.

(2) When firing inert or practice grenades, all linear distances may be reduced by 50 percent.

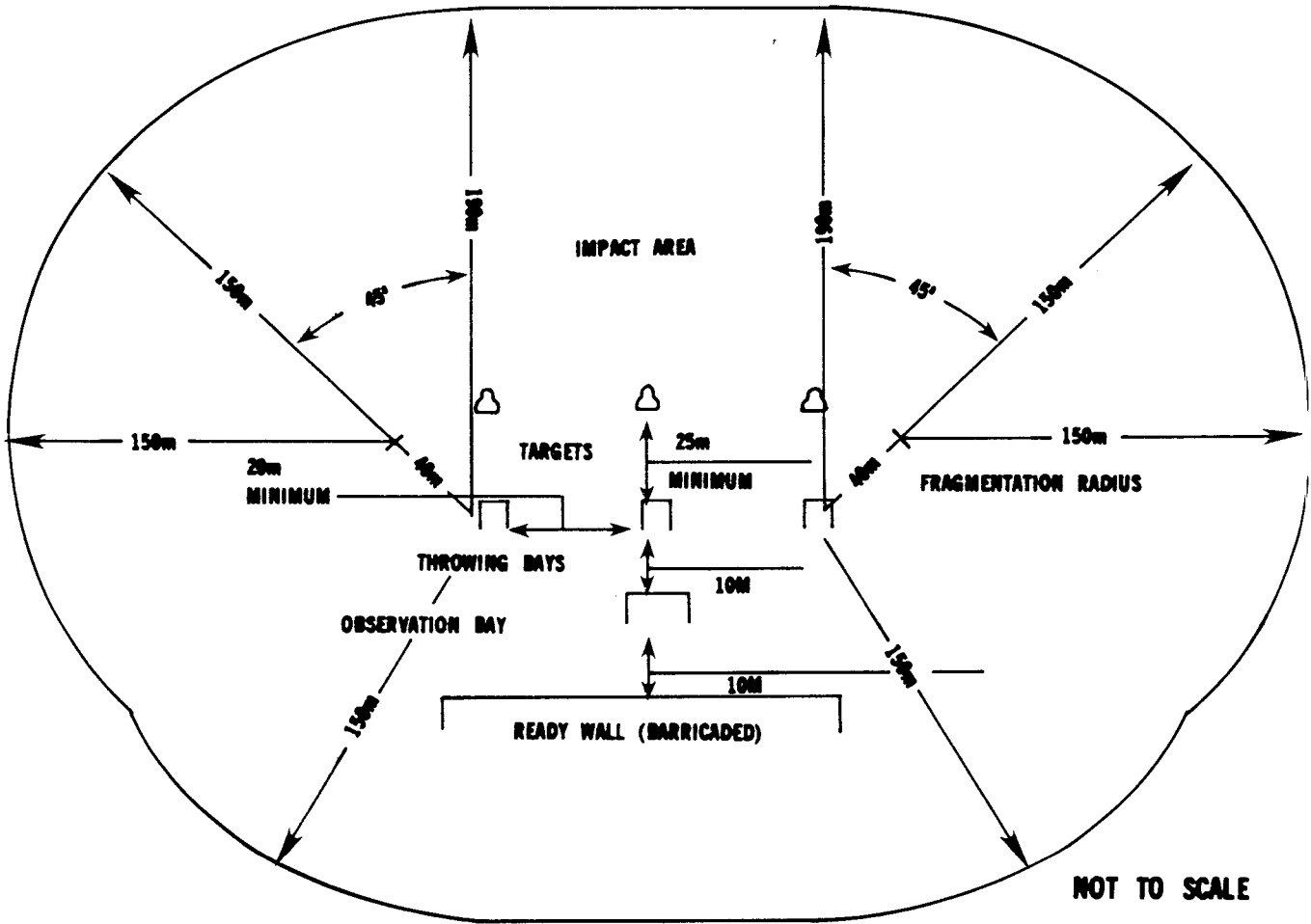
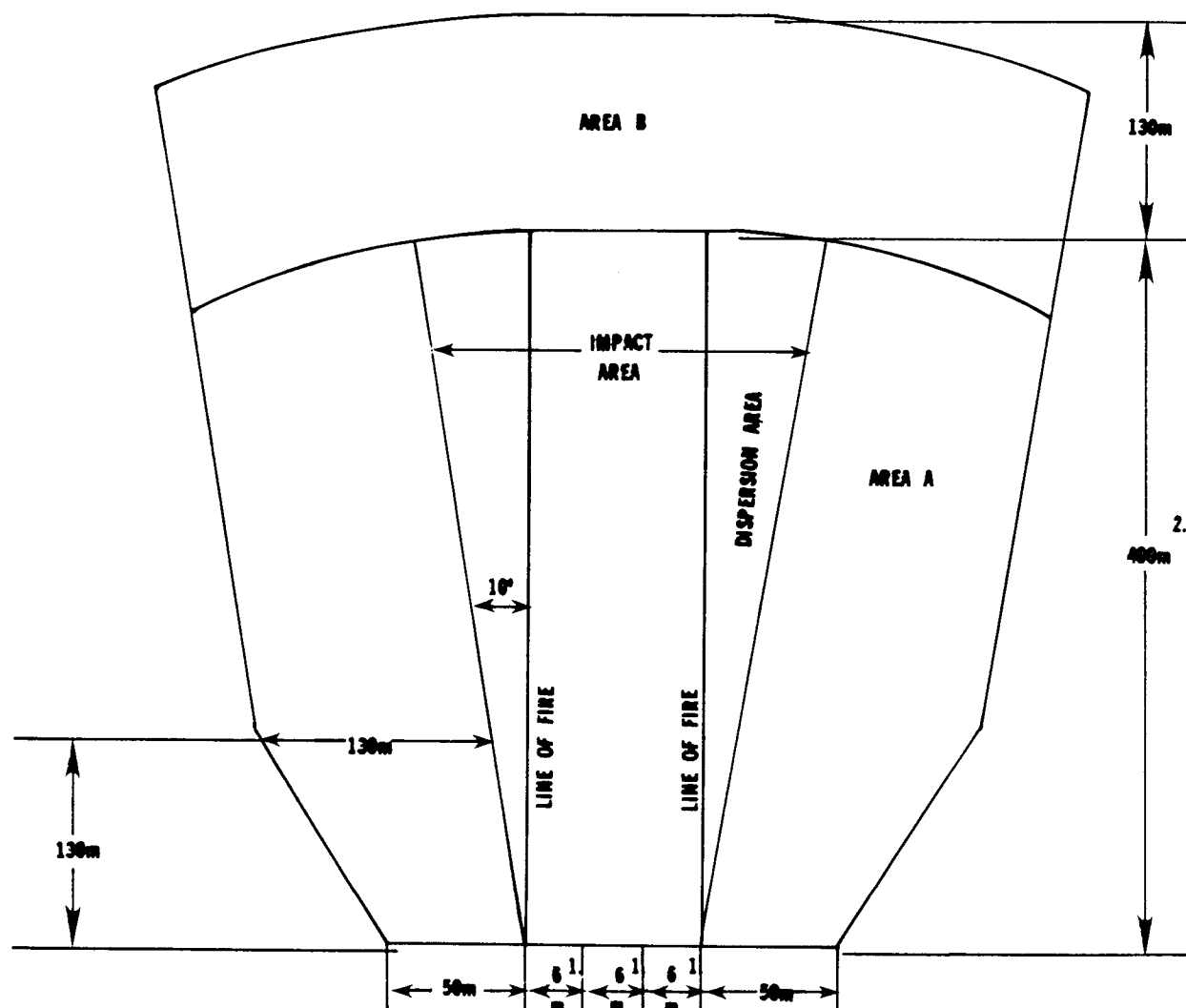


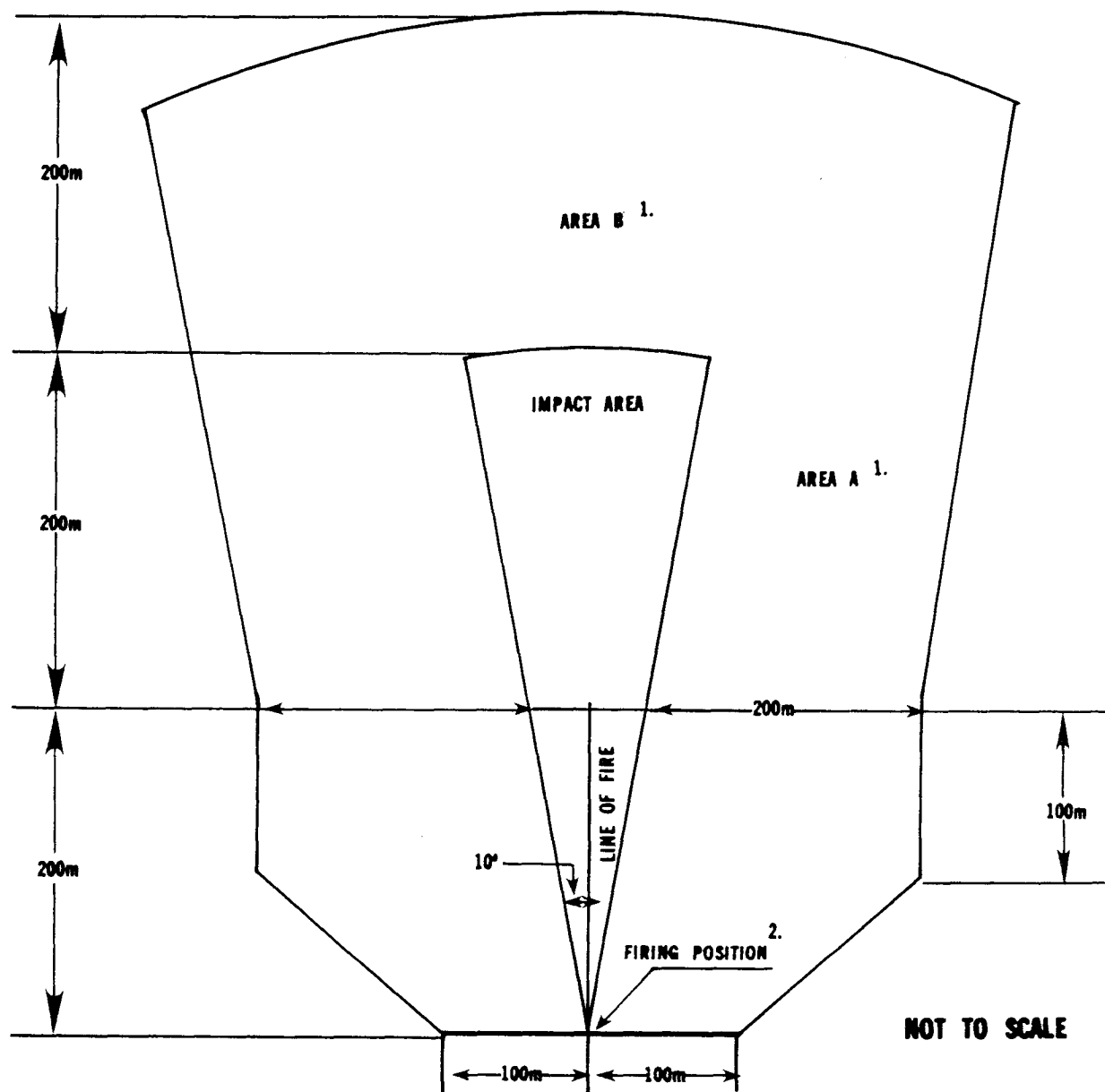
Figure 7-1. Surface danger zone for fragmentation and offensive handgrenades



NOT TO SCALE

- NOTES:**
1. Prohibit cross-lane firing when using multiple firing positions.
 2. Maximum range (400m) may be reduced when positive elevation control devices are used to limit range to impact distance.

Figure 7-2. Surface danger zone for firing M79 and M203 40mm grenade launchers

**NOTES:**

1. Areas A and B may be reduced to 150 meters for hand grenades.
2. Separation distance of 25 meters will be maintained between multiple firing positions.

Figure 7-3. Surface danger zone for firing rifle grenades and handgrenades with projection adapter

Chapter 8 Rockets

8-1. Firing conditions

The requirements in this chapter apply to the 35mm M73 practice rocket, 66mm M72 light antitank weapon (LAW) rocket, 66mm M74 incendiary rocket, and 3.5-inch rocket.

a. Before firing, the danger zone to the rear of the launcher will be cleared of personnel, materiel, and vegetation.

b. The danger zone to the rear of the launcher (Area F) is an isosceles triangle with apex at the breech and the width of triangle corresponding with rearward extension of line of fire. Base and depth of triangles are shown in table 8-1.

c. When firing the 35mm, 66mm, or 3.5-inch rockets from shoulder launchers, all loading preparation for firing and unloading will be on the firing line, with the muzzle pointed downrange.

d. When firing the 3.5-inch rocket from the shoulder, firing personnel will wear protective goggles at temperatures of 70 degrees Fahrenheit and above. At temperatures below 70 degrees Fahrenheit, the field pro-

tection mask will be worn to protect the eyes and face from small particles of unburned propellant that may be blown from the rear of the rocket as it leaves the muzzle of the launcher.

e. All backblast areas are doubled and firers should wear protective masks when the LAW is fired in temperatures below freezing.

f. Rockets will not be fired over the head of unprotected friendly troops unless protection provided against direct impact is adequate to defeat the type of rocket being fired.

8-2. 66mm LAW, M72 series; 66mm incendiary rocket, M74; and 35mm subcaliber practice rocket, M73

The danger zone for firing these weapons is shown in figure 8-1. Distances for Areas A, B, X, and F are given in table 8-1.

8-3. 3.5-inch rocket launcher

The dimensions shown in table 8-1 and figure 8-1 will be used to determine the danger zone for firing the 3.5-inch rocket launcher at fixed targets or moving ground targets.

Table 8-1
Rocket launchers
(Dimensions of areas in meters)
(See fig 8-1.)

Weapon	A	B	Minimum range to impact	X	F	
					Depth	Base
3.5-inch rockets	250	250	250 ¹	950	70	70
66mm HEAT rocket M72	250	250	75	1000	40	25
66mm incendiary rocket M74	100	100	50	1000	40	38
35mm subcaliber (Practice rocket M73)	100	100	50	1150 ²	40	25

Notes:

1. May be reduced 60 percent for short limit of target when firing nonexplosive warhead from unprotected positions or explosive warhead from protected positions.
2. May be reduced by waiver if there is steeply rising terrain behind the target or overhead baffles and positive controls are used to limit elevation of the launcher at the firing position.

Elevation (degrees)	Range (meters)	Maximum Ordinate (meters)
5	343	8
10	591	30
15	776	62
30	1082	203

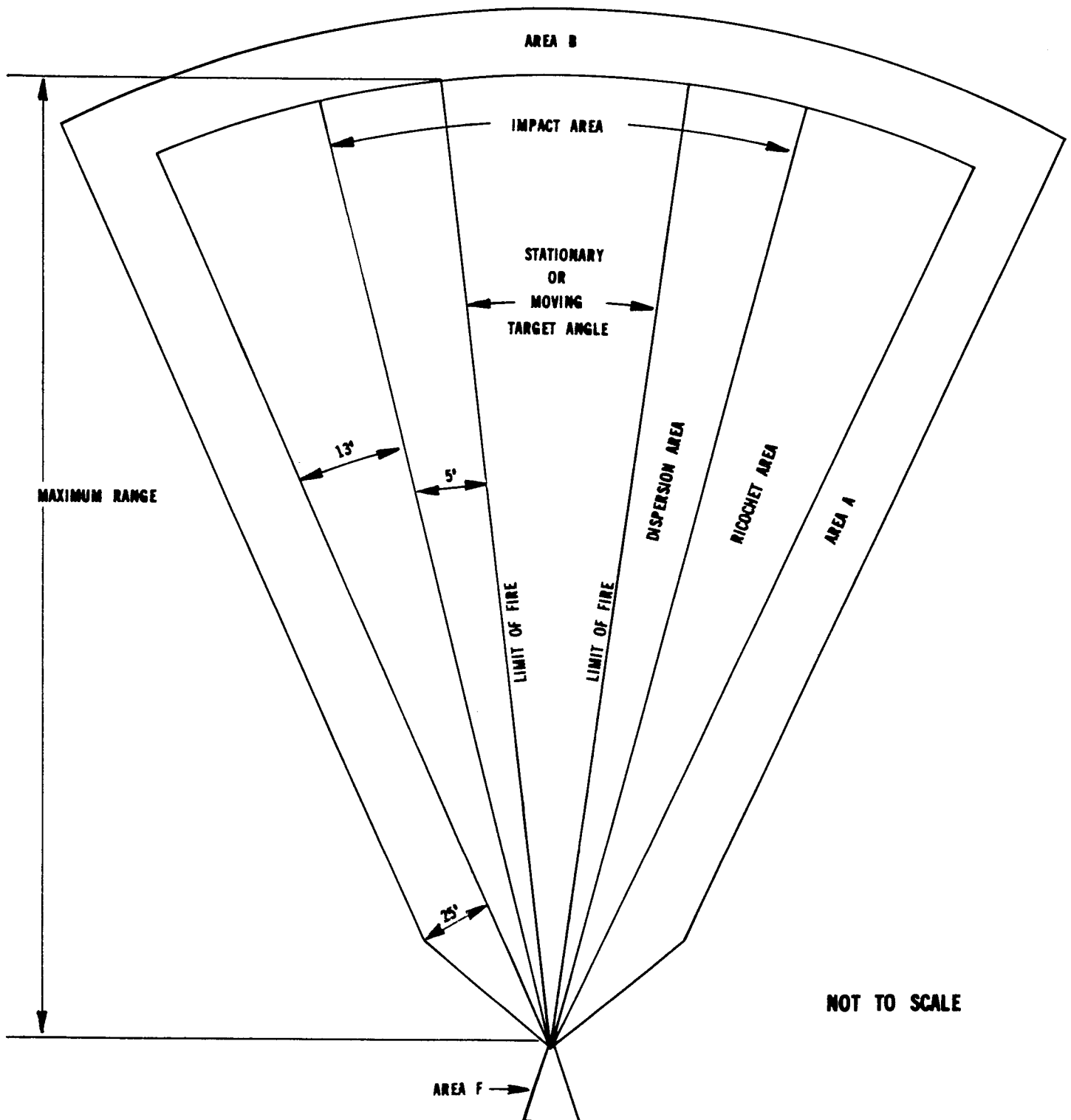


Figure 8-1. Surface danger zone for rocket launcher firing at fixed or moving ground target (See table 8-1.)

Chapter 9

Recoilless Weapons

9-1. Firing conditions

a. Personnel will not stand, or have any portion of the body, directly behind the rifle with ammunition in the chamber when opening or closing the breechblock.

b. Recoilless weapons will not be fired from within buildings or within 50 meters of a vertical or nearly vertical backstop.

c. All loose material, including expended cartridge cases, will be removed from Area F.

d. Recoilless weapons will not be fired over the heads of unprotected troops.

9-2. Surface danger areas

a. The surface danger zone when firing against fixed-ground targets (figs 9-1 and 9-2) consists of the impact area, Areas A and B, and a rear danger area (Area F). The dimensions of areas are given in table 9-1.

b. For the 57mm rifle, the rear danger area, due to blast and flying particles, is a triangle with apex at the breech, depth an extension of the line of the axis of the bore 15 meters rearward, and with a 30 meter base. There are 15 meters on either side of the bore axis extension.

c. For the 75mm, 90mm, 105mm, and 106mm recoilless rifles, the rear danger area, due to blast and flying particles, is a triangle with apex at the breech, depth an extension of the line of the axis of the bore 45 meters rearward, and with a 50 meter base. There are 25 meters on either side of the bore axis extension.

Table 9-1
Recoilless rifles
(See figs 9-1 and 9-2)

Caliber	A	B	Minimum range to impact ¹	X	15° ²	F	
						Depth	Base
57mm.....	250	300	250	4600	3200	15	30
75mm.....	300	350	300	6600	4300	45	50
90mm.....	300	350	300	2200	1500	45	50
105mm.....	300	350	300	8600	4900	45	50
106mm.....	300	350	300	6900	4800	45	50

Notes:

1. May be reduced by 75 percent when firing nonexplosive projectiles from unprotected positions or live projectiles from protected positions.

2. When firing antipersonnel cartridges at quadrant elevations of 15 degrees or less, use below listed distance X and Y. See figure 11-4 for surface danger zone construction method to incorporate Area Y.

Ammunition	X	Y
90mm, XM590E1	1900	1100
106mm, M581	5100	1800

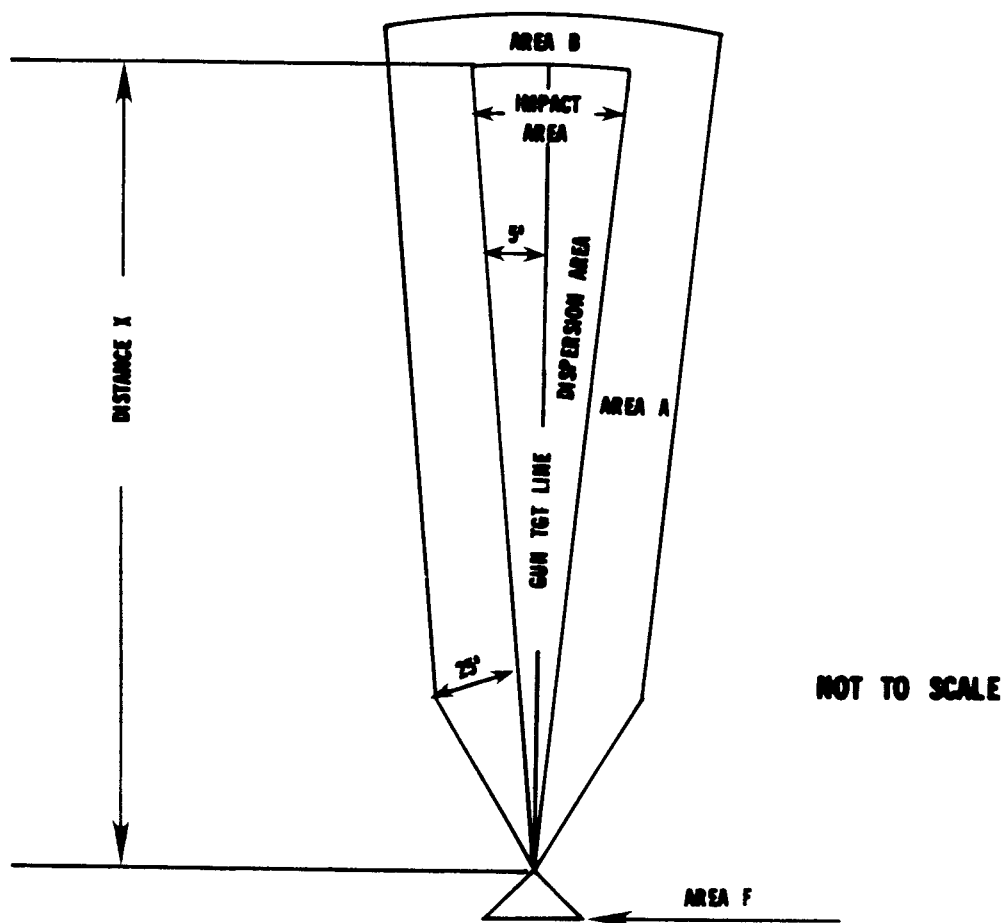


Figure 9-1. Surface danger zones for recoilless rifle firing at quadrant evaluation of 15 degrees or more (See table 9-1).

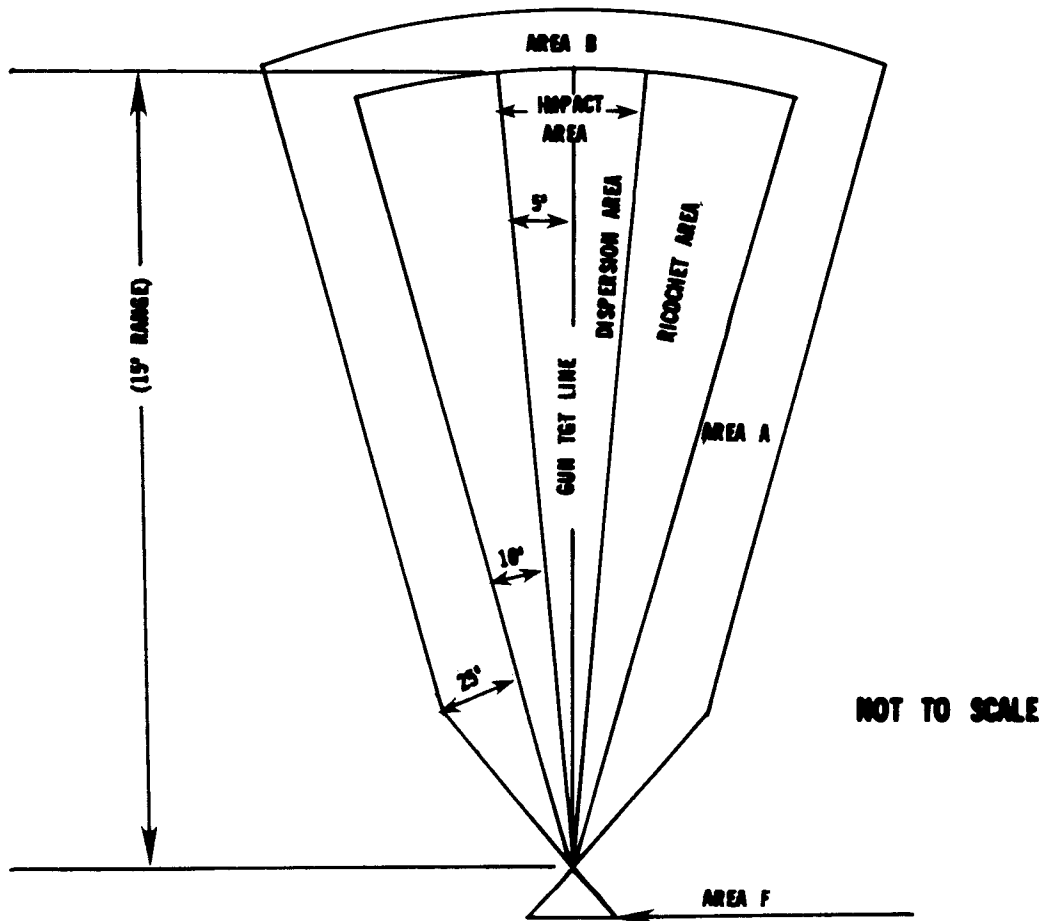


Figure 9-2. Surface danger zones for recoilless rifle firing at quadrant elevation of less than 15 degrees (See table 9-1.)

Chapter 10

Mortars

10-1. 60mm, 81mm, and 4.2-inch mortars

a. Firing 60mm, 81mm, and 4.2-inch mortars over the heads of unprotected troops is prohibited except for troops in tanks located 100 meters or more from the line of fire. Following firing instructions in TM 43-0001-28 and restrictions and suspensions in TB 9-1300-385-1 and TB 9-1300-385-2 for the rounds being fired.

b. High explosive, smoke, and TP cartridges fitted with PD fuze M52 series (not modified), M82 series, and M519 series will be used for combat emergency only.

c. All persons who take part in mortar firing will wear steel helmets.

d. Increments removed from rounds before firing, will be placed in a metal or wooden covered container located outside the firing vehicle/position at a safe fire

separation distance (25m).

e. DO NOT fire the M720 cartridge in the M19 mortar above propellant charge 2.

f. DO NOT fire the M720 cartridge with charge greater than 1 in the hand-held mode.

g. For firing restrictions and limitations on cartridges and fuzes, see TM 43-0001-28.

10-2. 4.2-inch mortar

a. Do not fire at an elevation greater than 1,065 mils (60 degrees).

b. Mortars assembled with fuze PD M51A5 will not be fired using less than 7 increments to insure constant arming of the fuze.

10-3. Surface danger areas for mortars

a. Distance X must not be less than the maximum range for the greatest charge to be used. (See fig 10-1.)

b. The dimensions of Areas A and B are given in table 10-1.

Table 10-1
Danger areas for mortars (Dimensions of areas in meters 1,2)
(See fig 10-1)

Caliber	A	B
60mm	250	300
81mm	350	400
4.2 inch.....	400	500

Notes:

1. The quadrant elevation limits must be modified to take into account the distance to the minimum and maximum limits of the impact area. Before registration, the target must be selected in the central portion of the impact area. After registration, registration corrections must be applied to deflection and quadrant elevation limits. When firing the 4.2-inch mortar, if registration firing is not conducted, metro and velocity error corrections will be applied to these limits, or all targets will continue to be selected in the central portion of the impact area.

2. Dimensions of areas A and B may be reduced by 50 percent when firing illumination cartridges.

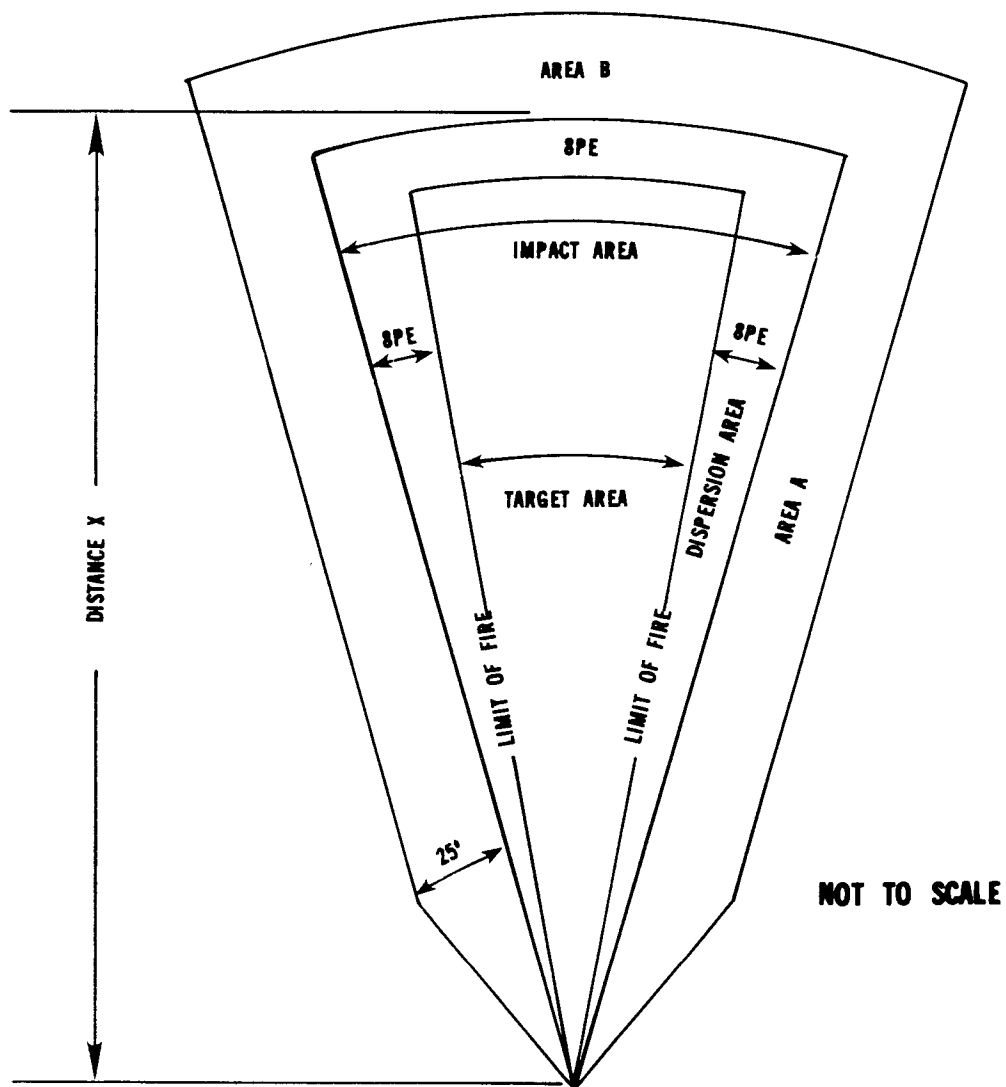


Figure 10-1. Surface danger zone for mortars firing at ground targets

Chapter 11 Artillery

11-1. Safety measures for combined arms live fire exercises (CALFEX) and service practice firings

This chapter contains the artillery preparations and precautions required during CALFEX with overhead and flanking indirect fire or both when maneuvering troops are involved and service practice firing when maneuvering troops are not involved. Sound gunnery procedures and good judgment are essential in the following areas:

- a. Verifying the lay of a battery.
- b. Maintaining a check system for each critical operation.
- c. Firing check rounds when large corrections due to meteorological data are determined.
- d. Selecting gun positions that minimize the danger to maneuvering troops.

11-2. Safety certification program

a. Commanders of field artillery units, battalion, and above, will establish and maintain an artillery safety training and certification program for their personnel. The purpose of the command safety certification program is to train and qualify individual members of the firing battery in the safety procedures for their specific areas of responsibility. When the responsible artillery commander is satisfied, through the use of intensive training and testing programs, that the individual members are qualified to perform the safety duties as required in the firing battery, then he or she will certify them as competent to perform those duties. The command safety certification program should be reviewed and approved by a full-time safety manager.

b. Field artillery commanders are responsible for safety during all phases of firing exercises under their control. They will determine, select, train, and safety certify the personnel necessary to assist them in discharging this responsibility. These personnel will include, but are not limited to, the firing battery commander, executive officer, assistant executive officer/fire direction officer (AXO-FDO), chief of firing battery, gunnery sergeant, fire direction center chief computer and gun/howitzer chief of section. If a TO/TOE/TDA position is not filled by a command safety certified individual, another individual command safety certified and qualified to fill that position will perform the safety checks.

c. The OIC will be the appropriate commander or his command safety certified direct representative. The OIC is responsible for all aspects of safety in the firing

unit and on the assigned firing range. Prior to the start of the firing exercise the OIC will be provided the required safety data and firing limitations by the range control officer. The OIC will—

(1) Verify that the unit is in the proper firing position.

(2) Supervise the conversion of the safety data into a safety diagram and insure that it is verified by a separate command safety certified individual. The safety diagram will provide right and left deflection limits, minimum and maximum quadrant elevations for authorized charges and minimum safe fuze times. The safety diagram will be provided, modified as necessary by the executive officer's minimum quadrant elevation, to the appropriate members of the firing battery.

d. The firing battery executive officer (position commander) is responsible for the safety practices of the firing battery. He will be assisted in his duties by the chief of firing battery or the gunnery sergeant.

e. The AXO/FDO will—

(1) Compute safety diagrams from the safety data and insure these are updated after registrations and receipt of current meteorological data. He will be assisted in his or her duties by the chief computer.

(2) Insure all firing data are within prescribed safety limits, before sending to the firing sections.

f. The chief of the firing section will—

(1) Insure that only safe practices take place at or near the weapon.

(2) Verify that the announced and proper data are applied to the weapon and the proper charge, fuze, and projectiles are fired.

(3) Insure that weapons are fired safely.

g. The RCO will provide the OIC of firing with the following safety data.

(1) The grid coordinates of the firing position.

(2) The lateral safety limits.

(3) The minimum and maximum ranges.

(4) Authorized ammunition to be fired (fuze, projectile, and charge).

(5) Airspace restrictions.

(6) Trajectory (high angle or low angle).

(7) Target area.

(8) The hours firing may be conducted.

h. A separate battery safety officer is not required during the firing of field artillery, but commanders may appoint one. The battery safety officer will—

(1) Be a command safety certified direct representative of the OIC.

(2) Be provided safety data by the OIC.

(3) Make safety checks to insure that —

(a) Only the authorized ammunition is fired (fuze, projectile, propellant).

(b) The rounds land within the designated impact areas.

(c) No unsafe practices takes place at or near the weapon.

(4) Not be required to verify all data placed on the on-carriage fire control equipment. He or she may rely on safety stakes, safety tape, or physical constraints on the weapon to insure that the safety limits are not exceeded.

11-3. Combined arms live fire exercise (CALFEX)

When field artillery is fired during a CALFEX with maneuvering troops, the impact area will be adjusted according to the maneuver location of troops to maintain safe separation distance. The troop side of the impact area will be determined in relation to the movement of the troops. Unprotected troops must not be permitted to enter surface danger zone Areas A, B, C, and E after firing has commenced.

a. Survey. Survey of the gun position or the center of the gun position area, registration points, and target positions will be accomplished as prescribed by current survey procedures. Minimum safe limits for maneuvering troops will be designated by markers such as ground markers, engineer tape, trees, prominent terrain features, and roads that will permit quick and easy identification in any weather condition, day or night.

b. Firing data. Firing data may be derived by appropriate means. This does not apply to emergency fire direction procedures.

c. Weapons. Weapons will be grouped by muzzle velocity as cited in FM 6-40 or pertinent Marine Corps technical directives. Weapons will be bore-sighted as prescribed in FM 6-50. Tubes will be clean and dry before start of exercise and will be cleaned during the exercise in accordance with appropriate weapon TM's.

d. Ammunition. Only ammunition as approved in paragraphs 3-2i, 11-6c, and 16-4c may be used for CALFEX. All ammunition to be fired should be uniformly conditioned to ambient temperature as much as possible consistent with the tactical situation. Storage, transportation, and handling of ammunition will be in accordance with safe handling requirements.

e. Registration.

(1) At least two rounds should be fired for registration. Targets should be selected in the central portion of the target area. After registration, registration corrections must be applied to deflection and quadrant elevation limits. If no registration is fired, meteorological and velocity error (MET + VE) corrections will be applied. At least two rounds will be fired to validate MET + VE corrections immediately before the exercise starts. Targets will continue to be selected in the central portion of the target area. The quadrant elevation limits must be modified to take into account the site to the

minimum and maximum limits of the target area.

(2) To compensate for drift, in high-angle fire, the right deflection limit will be moved to the left by the amount of the maximum drift listed within the range limits for the charges being fired. The left limit will be moved to the left by the amount of the minimum drift listed within the range limits for the charges being fired. To determine the appropriate drift, the tabular firing table and graphical firing scale must be examined and the safer value used. If a drift value is not listed in the tabular firing table or on the graphical firing scale for the ranges to the near and far edge of the target area, the nearest safer value will be used.

11-4. Service practice

Service practice is a practical firing exercise in the use of service ammunition. It does not involve maneuvering troops. The limits of the impact area are designated by the range control officer.

a. Survey. There are no survey requirements if the firing unit is within the limits of the firing position as established by the range control officer.

b. Firing data. Firing data may be derived by appropriate means, including emergency fire direction procedures.

c. Weapons. Weapons should be clean and dry before the start of service practice firing.

d. Ammunition. No restrictions exist for ammunition except as noted in chapter 3 and paragraph 11-6c.

11-5. Surface danger zone

The basic dimensions of danger zones for all field artillery cannon are shown in tables 11-1 through 11-7 and figures 11-1 through 11-5.

a. Target area. The range control officer determines the boundaries of the target area. The left limit of the target area establishes the left limit of fire. The right limit of the target establishes the right limit of fire. The maximum range line will be the far edge of the target area. The minimum range line will be the near edge of the target area. When firing at moving targets with indirect fire, an additional 5-degree angle of area will be provided on each side of the impact area between the outer limits of the impact area and the inner limits of Area A. Personnel access to the target area is prohibited during firing.

b. Impact area. The actual size of the impact area will depend on the requirements of the firing exercises planned.

(1) The basic dimensions of the impact area will be computed as follows:

Limits	Dimensions
Left	Eight deflection probable errors from the left limit of the target area.
Right	Eight deflection probable errors from the right limit of the target area.

Far edge Eight probable errors from the far edge of the target area.

Near edge Twelve range probable errors from the near edge of the target area.

(2) The firing table probable errors corresponding to the range to the center of the target area will be used for this computation. These basic dimensions are based on standard conditions. They do not compensate for errors or nonstandard conditions.

(3) Personnel will not be allowed in the impact area except as follows:

(a) Light artillery fire, up to and including 105mm howitzer, may be impacted within 100 meters of occupied bunkers located within the impact area. Bunkers must have been constructed and approved to protect personnel from a direct hit by the round and weapon being fired. Also, constant communication must be maintained with the firing position and the bunkers. Observation from the bunkers will be by indirect viewing such as periscopes and mirrors unless an approved design for direct observation has been provided.

(b) Medium and heavy artillery fire, above 105mm, may be impacted within 200 meters of occupied bunkers located within the impact area. Bunkers must have been constructed and approved to protect personnel from a direct hit by the ammunition and weapon being fired. Also, constant communication must be maintained with the firing position and the bunkers. Observation from the bunkers will be by indirect viewing such as periscopes and mirrors unless an approved design for direct observation has been provided.

(c) Bunkers to be used in accordance with (a) and (b) above will be designed and constructed using specifications provided by the facility engineer. They will be reviewed for final approval by the installation safety manager to insure that structural integrity is maintained against direct hits and penetration by fragments. Direct viewing methods will be designed and constructed according to specifications provided by the facility engineer. They will be reviewed for final approval by the installation safety manager to insure personnel are protected against penetration by fragments generated in the impact blast.

c. *Area A.* This is the lateral danger area of the surface danger zone. The size of Area A will vary according to the caliber of weapon being fired. Personnel access to Area A is prohibited except when bunkers constructed in accordance with b(3)(c) above are used.

d. *Area B.* This is the down range danger area of the surface danger zone beyond the impact area. The size of Area B will vary according to the caliber of weapon being fired. Personnel access to Area B is prohibited except when bunkers constructed in accordance with b(3)(c) above are used.

e. *Area C.* This is the danger area adjacent to the

near edge of the impact area. The size of Area C will vary according to the caliber of weapon being fired and the ammunition. Personnel access to Area C is prohibited unless cover designed to provide positive personnel protection (b(3)(c) above) in case of a direct hit. Access to Area C by personnel in tanks and armored personnel carriers is permitted when firing artillery rounds with VT or T fuzes. When firing artillery rounds with VT or T fuzes over tanks and armored personnel carriers, the height of burst above ground level in table 11-2 will be used to provide an adequate degree of safety to protect the personnel and vulnerable parts of the vehicles. The following procedures apply when firing over tanks and armored vehicles:

(1) Increase the height of burst by a minimum of four probable errors in burst height when computing the firing data.

(2) Do not use weapons of caliber greater than 155 mm.

(3) Use sufficient quadrant elevation so that if the time element of the fuze fails to function, the projectile will land a distance beyond the tank equal to the predicted height or burst plus four probable errors in range.

f. *Area D.* This is the danger area located between danger Areas C and E. The size of Area D will vary according to the required dimensions for the target area, impact area, and danger Areas A, C, and E. Area D, during indirect fire under standard conditions, is the area with the surface danger zone where the hazards are minimal. It can be occupied by unprotected military troops for training. The installation commander may authorize personnel other than military troops in training access to Area D during the indirect firing of field artillery. Area D will not be occupied during direct fire of field artillery. The following precautions apply when any part of Area D is occupied:

(1) The trajectory of the round must clear any unprotected personnel or objects by at least 5 meters plus two forks. If this minimum range line is greater than the distance to the near edge of the target area, use the computed minimum range line for the near edge of the target area.

(2) Unless personnel are provided cover designed to withstand a direct hit, the minimum arming time of the proximity (VT) fuze establishes the near edge of the impact area. Although most proximity fuzes with settable arming time can arm in flight about 3 seconds before the time set on the fuze, an appreciable risk exists that arming will occur as early as 5.5 seconds before the set time. The minimum arming time of the proximity (VT) fuze will be the time set on the fuze corresponding to the ranges to the near limit of the impact area plus 5.5 seconds.

(3) Unprotected military troops in the surface

danger zone must maneuver within the confines of Area D. If the forward movement of the troops requires advancing beyond the established limits, then the surface danger zone must be advanced according to the distance and direction of the troops. If proximity fuzes are being used, such a forward movement is possible only when fuzes with settable arming time are being used. In firing fuzes with settable arming time (VT), the time set on the fuze corresponding to the range to the near limit of the impact area will be increased by 5.5 seconds.

(4) Firing of ICM and antipersonnel-type projectiles over the heads of troops in training is prohibited. Access to Area D is not permitted when firing ICM antipersonnel projectiles.

(5) When rocket-assisted projectile rounds are fired over the heads of troops, the dimension of Area D will be based on the trajectory of the projectile. This results from standard propellant charges fired in the rocket off mode.

(6) Installation public roads that have been approved by the installation commander for use by unprotected personnel (military and civilian) during artillery firing will have signs posted warning the public that artillery rounds may be fired over the roads. The requirements of chapter 2 must also be followed.

g. Area E. This is the danger area located immediately in front of the firing position. The size of Area E will vary according to the caliber of weapon fired and the ammunition. It is an area of variable danger from overpressure, noise, ground, and muzzle debris or other potential injury related to weapon firing. This includes premature detonation of the weapon.

(1) Since Area E is an area of variable hazards, personnel access out to the following distances from the gun position is prohibited. This does not apply to weapon crews firing from an approved tactical configuration and operational personnel involved in the firing exercise with a valid need to enter this area as approved by the installation commander.

(a) 300 meters for 90mm and 105mm weapons.

(b) 350 meters for 120mm, 155mm, and 8-inch weapons.

(c) 450 meters for 157mm weapons.

(2) Personnel access to the remainder of Area E during indirect fire or artillery will be at the discretion of the installation commander. Personnel access to the remainder of Area E during direct fire is prohibited.

h. Distance X. Distance X will be equal to the maximum range of the weapon at the elevation to be fired and for the charge used. When firing in the direct mode, distance X will not be less than the range of the weapon corresponding to an elevation of 267 mils for the charge used.

11-6. Operational safety factors

a. Cannon using separate loading ammunition. For

cannon using separate loading ammunition, the lanyard will not be attached to the firing mechanism until the designated crewman has announced "READY."

b. Procedures for blast overpressure. Special firing procedures will be followed for weapons and weapon systems that produce blast overpressure problems with specific charges. These firing procedures are intended to reduce the risk of artillery crews for auditory and non-auditory injury from blast overpressure. Individuals who have shortness of breath or chest discomfort, bleeding from mouth, nose or ears or excessive shakiness (tremors) directly related to weapon firings may be suffering from a blast overpressure injury. Those with any of these signs or symptoms should be instructed to lie down and remain immobile. They must then be transported as a litter patient to the nearest medical facility for immediate evaluation and treatment as indicated. Refer to specific weapon or weapon system TM for designated firing procedure.

c. Fuzes.

(1) The alteration of fuzes is prohibited unless specifically authorized by the CG, DARCOM, and unless supervised by a qualified DARCOM commissioned officer or civilian.

(2) In handling ammunition, protect the point of fuzes from blows or damage, since the closing cap may be deformed sufficiently to function the percussion primer in the fuze. Those who insert a round of ammunition into the gun will be cautioned to keep each round well away from the path of gun recoil until recoil from the previous round has taken place.

(3) In fuzing ammunition, insure that the proper fuze is screwed down by hand and then firmly seated with the correct fuze wrench.

(4) If approved procedures permit forcing rounds from weapon tubes with a rammer staff, these rounds will not be reused. This method of removal may damage the round and make it unsafe to fire. These rounds will be declared unserviceable and disposed of properly.

(5) All cartridges and projectiles fired during training will be fuzed with boresafe fuzes. No protection for personnel at the gun is required when high explosive ammunition with boresafe fuzes are fired.

(6) Fuzes assembled to cartridges and projectiles fired during training exercises will be the type that will preclude a close-in premature burst that would present a fragment hazard to the firing crew. When ammunition assembled with other than these types of fuzes are fired, all personnel within Area A distance from the firing position will be provided with position protection against premature bursts. When only white phosphorous ammunition is involved, this distance may be reduced to 200 meters. Positive protection at the weapon position will meet the following minimum requirements:

(a) Two thicknesses of sandbags filled with dry sand for all calibers up to and including 75mm and four

thicknesses for all other larger calibers high enough for proper cover.

(b) Trenches deep enough to provide complete cover or concrete walls 1 foot thick or tanks with hatches closed.

(7) Firing a cartridge or projectile without the fuze is prohibited.

11-7. Malfunctions

Malfunctions that occur during firing of ammunition will be investigated and reported in accordance with AR 75-1 and MCO 8025.1.

11-8. Misfire, hangfire, and cookoff

Procedures to be followed when a misfire or hangfire occurs, or when the potential for a cookoff exists, are in TM 43-0001-28 and appropriate weapon TM.

11-9. Excessive pressures in cannon

Excessive pressures are dangerous, but are not likely to occur when authorized and properly maintained ammunition is fired in a properly maintained and operated weapon.

a. Do not load or fire ammunition at a temperature higher or lower than the safe limit of firing. After loading, fire the weapon, or in case of a cease fire, immediately remove the cartridge or projectile. If the cartridge or projectile cannot be removed from the weapon within 5 minutes, evacuate all personnel to a distance equivalent to Area A for the munition. (See TM 43-0001-28 and appropriate weapon TM.)

b. Use only propellant charges of the type authorized for the particular round or weapon. Never use more charges than those comprising the authorized full charge for the particular round or weapon.

11-10. Improved conventional munitions

ICM projectiles are designed to produce a more uniform pattern of fragmentation effects, thus increasing the probability of killing or disabling the target.

a. *Maximum range.* Conventional firing table data for the particular caliber projectile/gun combination (table 11-3) will be used to determine maximum range when firing ICM projectiles.

b. *Impact area.* Based on the serious hazards in locating and disposing of duds, ICM munitions should be fired into a dedicated impact area. The impact area should be relatively flat and free from heavy vegetation.

c. *Secondary danger area.* Danger Areas A and B will be observed for all firings of ICM projectiles. The data necessary to determine each of these areas are in table 11-4.

d. *Submissile drift factors.* The special design of ICM projectiles subjects them to the effects of wind velocity more than standard conventional projectiles.

These submissile drift factors are given in table 11-5. These may be added to or subtracted from the basic trajectory distances presented in the firing tables. (For example, if the wind is blowing at 50 knots from the gun position toward the target and the gun is being fired at 600 mils, the maximum range from the firing table will be increased by 150 meters; if the wind is coming perpendicular (left to right) to the gun target line, the right deflection will be increased 160 meters and the left deflection will be decreased 160 meters.)

e. *WARNING.* ICM projectiles will not be fired over the heads of troops in training exercises. Access to Area D is not permitted when firing ICM antipersonnel projectiles.

f. *CAUTION.* Uprange and lateral ricochets of up to 500 meters may occur when ICM carriers that fail to function impact in other than soft soil.

11-11. Antipersonnel ammunition (beehive)

Antipersonnel ammunition are designed for use against personnel in direct fire, muzzle action, and direct fire mission with a time setting.

a. The surface danger zone for antipersonnel ammunition is in figure 11-4. Data necessary to determine the surface danger zone are in table 11-6.

b. Distance X is based on the range at 267 mils (15 degrees) quadrant elevation.

c. Hardware discarded by functioning of the projectile presents a potential hazard to personnel to the side and rear of the weapon.

11-12. M31 field artillery trainer

The 14.5mm, M31 trainer is a shortrange, subcaliber weapon. It can be used in artillery weapon training exercises or demonstrations where firing range distances are not available for standard weapons firing standard service rounds. Commanders may authorize firing of the M31 trainer on permanent firing ranges or in other approved training areas when firing is in accordance with safety requirements of this regulation.

a. Firing precautions.

(1) Based on information obtained during test firing of 14.5mm ammunition, dud projectiles will occur when firing the M31 trainer, especially when firing on hard soil and macadam/concrete. When firing exercises are completed on a temporary range or local training area, the surface danger zone will be cleared of all duds and projectile residue (*d* below) before allowing people to enter the area. Dud projectiles with time-delay elements (M181 and M182 cartridges) when functioned may cause metal particles to be propelled at velocities up to 200 feet per second. Since the dud projectiles for M183 cartridge will not fragment upon functioning, firing the M131 trainer on a temporary range or local training areas will be restricted to that cartridge only.

(2) The M31 trainer tube must be cleaned after firing each 10 rounds to prevent premature functioning of the projectile.

b. Malfunctions. Malfunctions during firing of the M31 trainer will be handled in accordance with TM 9-1300-206 and TM 9-6920-361-13&P.

c. Surface danger zone.

(1) The surface danger zone consists of the firing position, target area, impact area, and Areas A and B as shown in table 11-7 and figure 11-5. The ammunition fired will be restricted to propellant charge 1 only.

(2) The dimensions of the surface danger zone depend on the nature of the firing and the type of surface conditions within the surface danger zone. The RCO and the OIC will make an accurate evaluation of the firing conditions and range facilities before using the minimum dimensions shown in table 11-7. When the range to target falls between distances shown in table 11-7, the next larger distance will be used in developing the surface danger zone. No provision is made in table 11-7 for uncorrected errors, improper evaluation of range conditions, or for errors in laying the weapon.

(3) Personnel access to the surface danger zone is prohibited unless positive protection is provided against ricochet and projectile impact. When positioning of personnel in the surface danger zone is necessary, the protection provided them will be examined by the installation safety manager and facility engineer. They will determine the protective capability and structural integrity of the protective structures.

d. Dud retrieval. Procedures in paragraph 2-9 to dud retrieval.

(1) On completion of M31 firing exercise or demonstration in a temporary range or in a local training area, the surface area will be searched for dud projectiles. Stakes bearing yellow flags will be used to designate the location of duds.

(2) Personnel will retrieve duds with authorized equipment only. They will not pick up duds with their hands or disturb duds during search operations.

(3) The retrieving equipment must protect personnel against projectile flight and fragmenting in case the fuze functions during retrieval. Retrievers used to collect duds in an area where only the M183 cartridge was fired need only provide protection against projectile flight. Long-handle tongs (24 inches or longer) will be used to retrieve dud projectiles from the M183 cartridge. All personnel who retrieve duds will be trained on safe techniques for retrieving duds and will wear safety goggles. Projectiles will be carried at the side of the body, parallel to the ground with fuze end forward.

e. Dud disposal. Dud projectiles will be disposed of by blowing the projectile in place using standard demolition methods or by collecting and burning them in an open pit. When using the open pit burning method, use enough combustible material to insure burning of the fuze and smoke composition. Procedures in paragraph 4-7 must be strictly adhered to for dud disposal.

11-13. M/12 Canon Launched Guided Projectile (Copperhead)

a. The special surface danger zone construction criteria are shown in figures 11-6 and 11-7.

b. The fire support team (FIST) personnel located in the mission essential area (MEA) are required to wear flak jackets and steel helmets.

c. Occupancy of the SDZ by FIST personnel when firing in the ballistic mode is not permitted.

d. The MEA must start at least 1.5km from the target point and not exceed 5km from target point. MEA must remain outside the prohibited area of the SDZ.

e. Laser designator will be operated in accordance with safety guidelines in chapter 19.

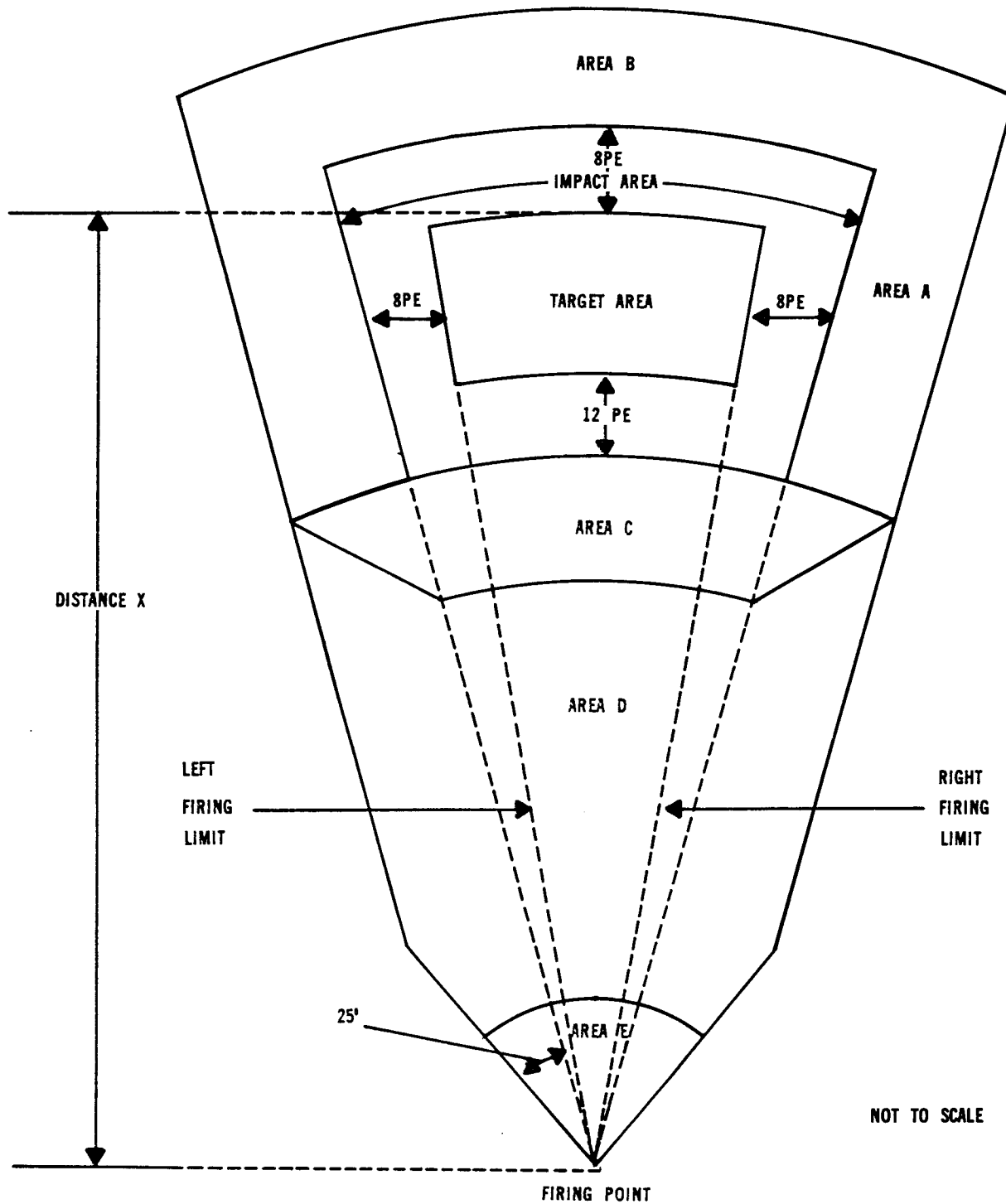


Figure 11-1. Artillery cannon firing at fixed or moving ground targets in the direct mode

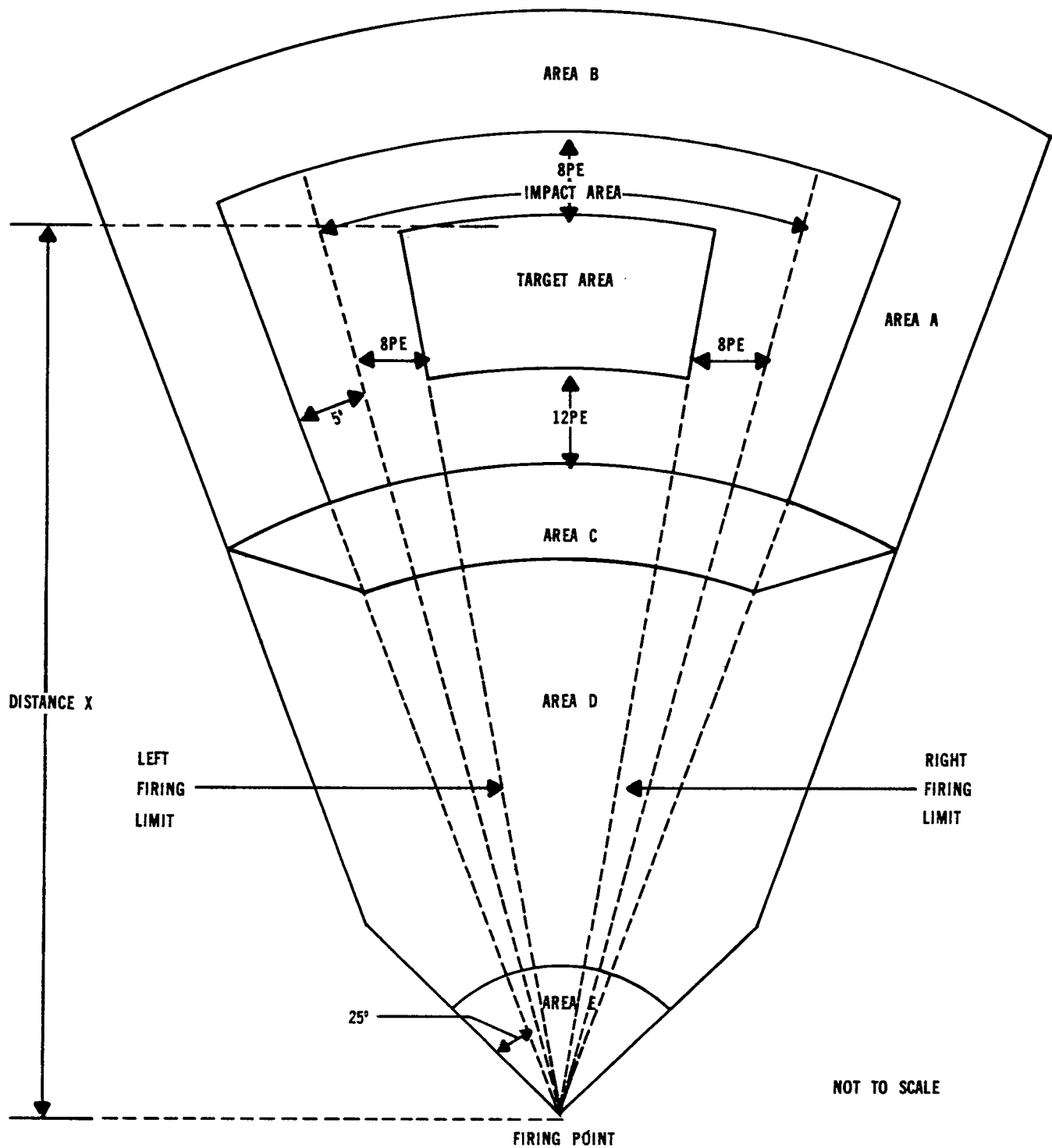


Figure 11-2. Artillery cannon firing at moving ground targets in the indirect mode

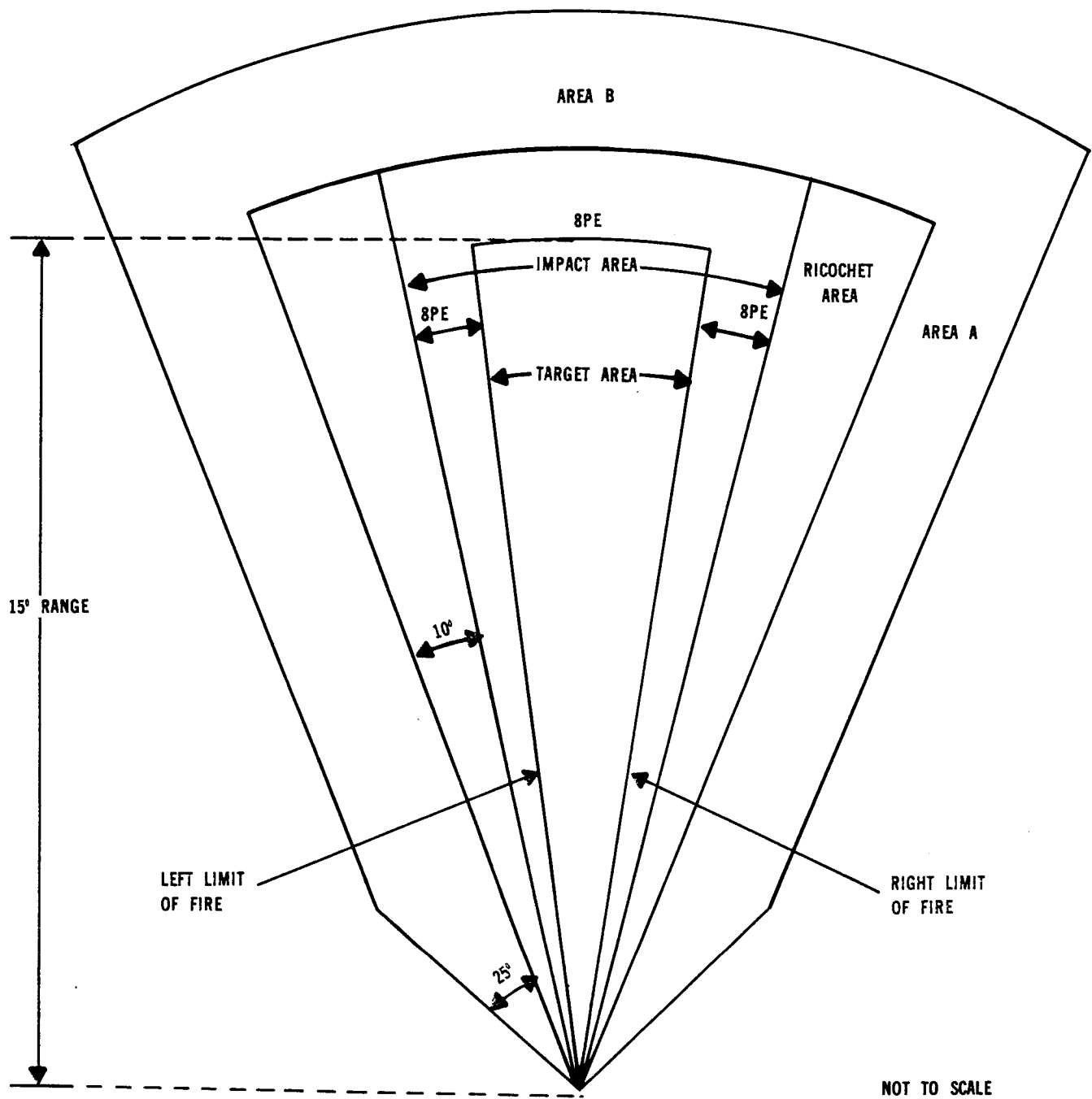
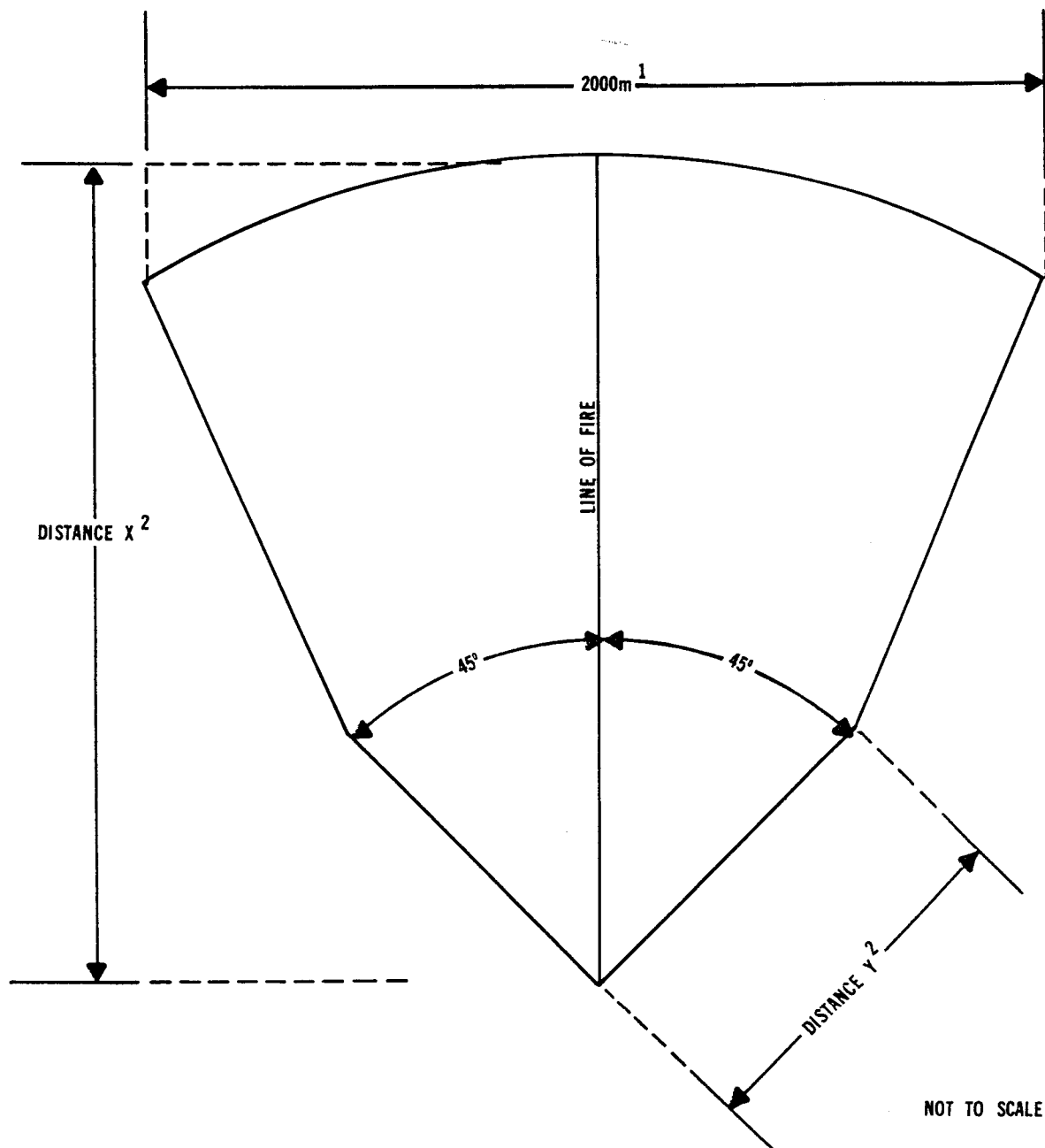


Figure 11-3. Artillery cannon firing at fixed or moving ground targets in the direct mode



Warning. Hardware discarded by the functioning of the projectile presents a potential hazard to unprotected personnel located to the side and rear of the weapon.

1. Distance is 2000 meters or 1.414Y, whichever is greater.
2. For Distance X and Distance Y see Table 11-6.

Figure 11-4. Artillery cannon firing antipersonnel-type ("Beehive") munitions

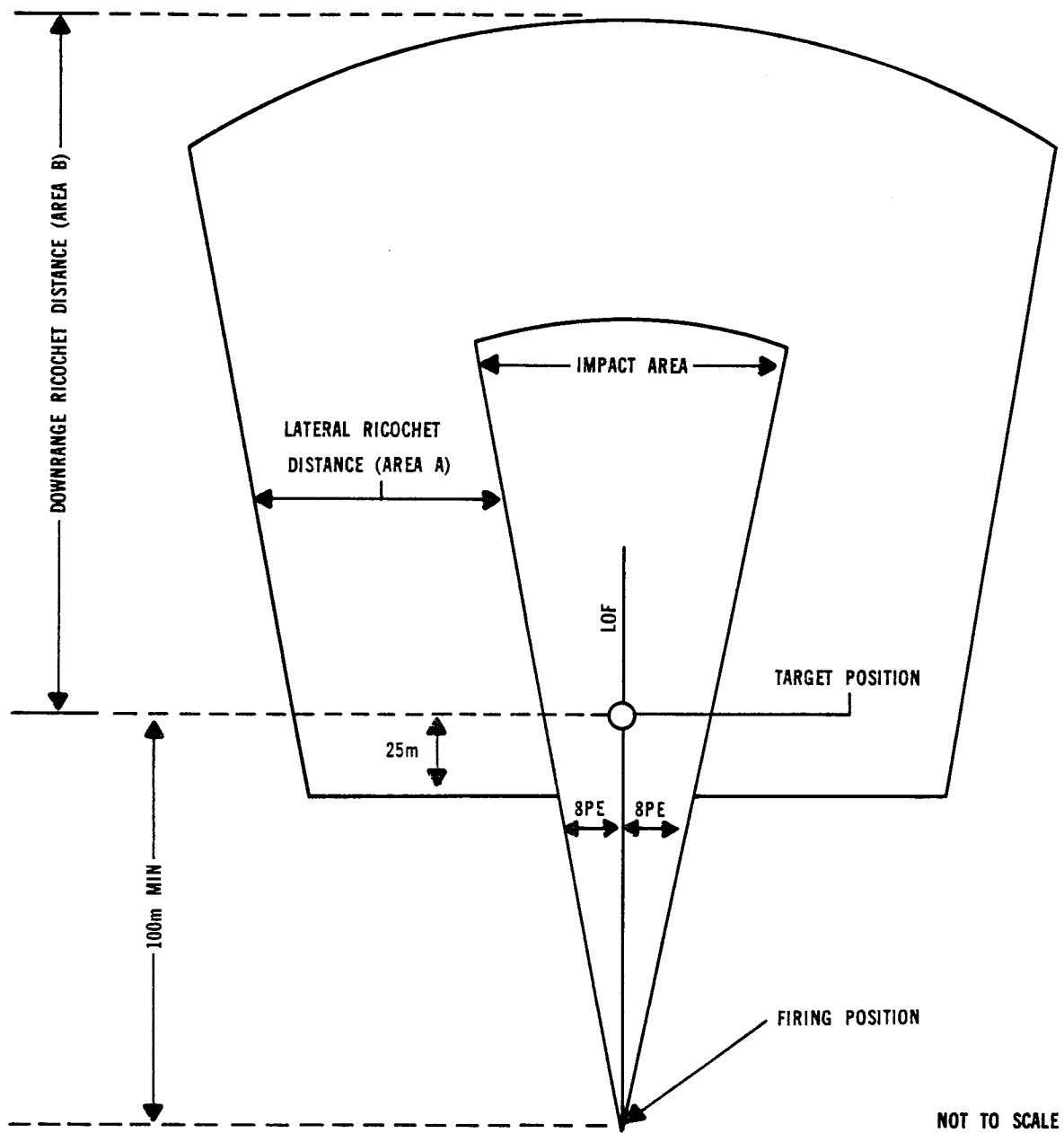


Figure 11-5. Firing 14.5mm ammunition with charge 1 propellant in the M31 field artillery trainer

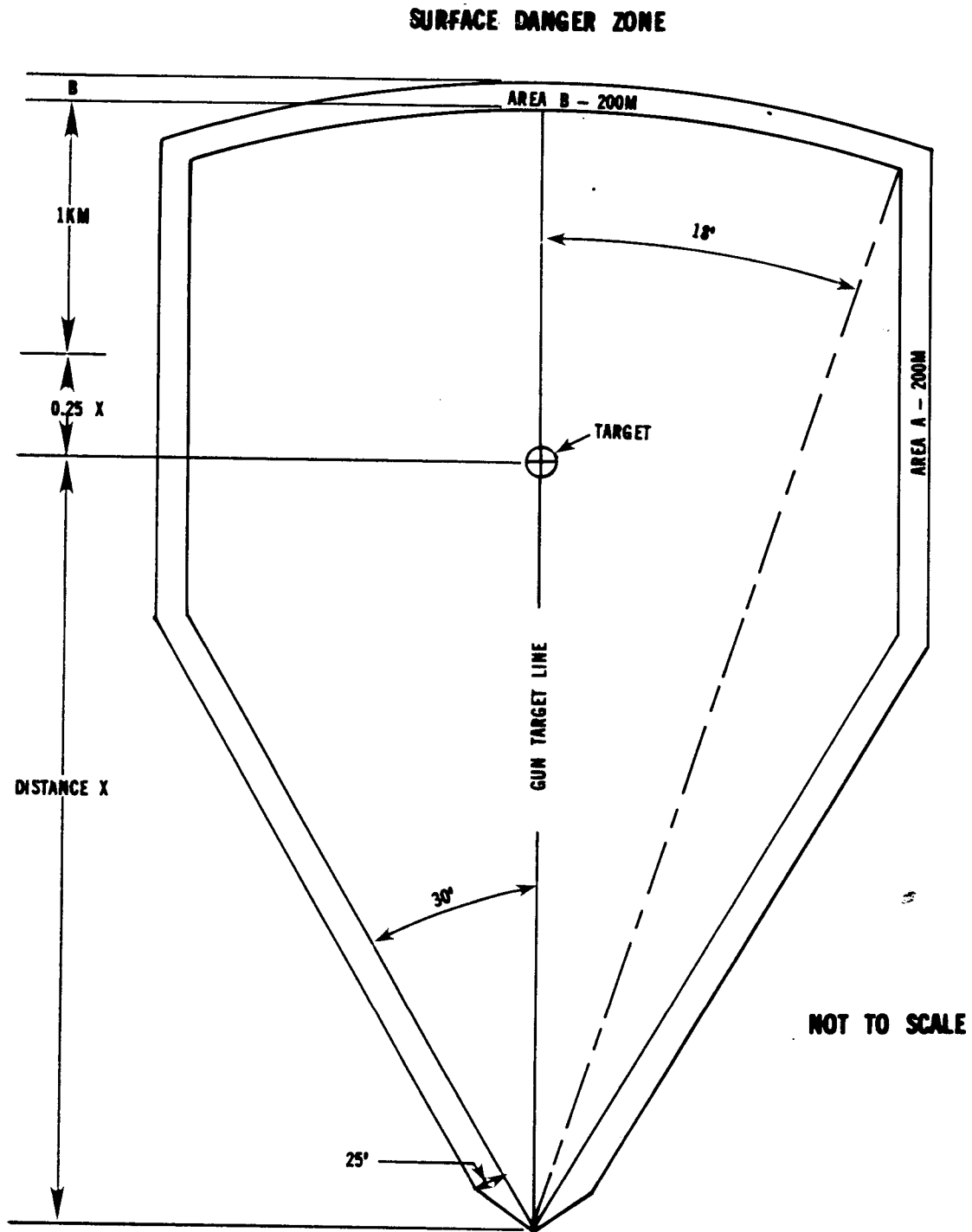


Figure 11-6. Point target, ballistic mode

SURFACE DANGER ZONE

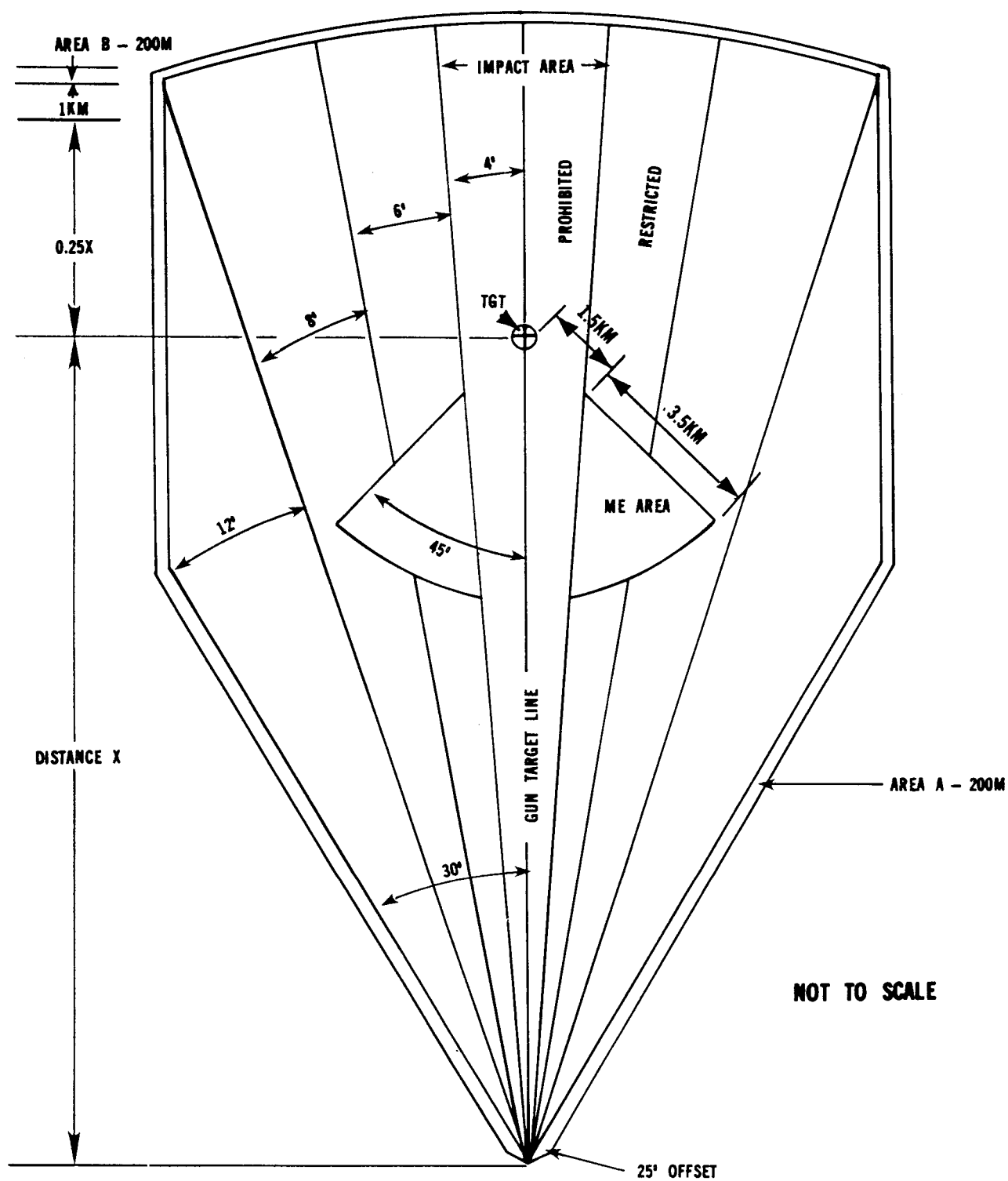


Figure 11-7. Point target, glide mode

15 October 1983

Table 11-1. Dimensions of Areas for Field Artillery Cannon

Caliber ²	Area A ¹	Area B ²	Area C ³ Low Angle Fire	Area C ³ Time, VI	Area E	Dir Fire ⁴ Mode
				High Angle Fire		
105mm how	550m	550m	300m	350m	550m	650m
155mm how	725m	725m	350m	550m	725m	750m
175mm gun	745m	745m	450m	600m	745m	800m
8-inch gun	830m	830m	650m	800m	830m	850m

1 Dimensions of Areas A and B may be reduced by 50 percent when firing illumination projectiles.

2 Firing will be conducted only with charges that have a maximum range of at least 1,400 meters beyond the near edge of the impact area.

3 When the headings of more than one column relate in some way to the type of firing to be conducted the column giving the larger value of C will be used.

4 Distances in this column represent minimum target engagement distances when personnel at the firing position are unprotected. All unprotected personnel located within Area E must be separated from engaged targets by this distance.

Table 11-2. Heights of Burst Above Occupied Armored Vehicles

Vehicle	Distance 90mm	Above 105mm	Vehicle 155mm
Armored vehicles ¹	65m	125m	150m
Tank M48	40m	40m	55m
Tank M60	40m	40m	55m
Tank XM1	40m	40m	55m

1 Includes series M113, M125, M106, M728, M577, M551, XM2(IFV) and XM3(CFV).

Table 11-3. Maximum range data sources for ICM projectiles

M444 - Standard 105mm Firing Tables for M1.
 M449 - Standard 155mm Firing Tables for M107.
 M404 - Standard 8-inch Firing Tables for M106.
 M483 - Standard 155mm Firing Tables for M483.
 M509 - Firing Tables FT 8-T-0.

Table 11-4. Secondary danger areas (A, B) for ICM projectiles

ITEM	AREA A	AREA B
105mm M444	440m	440m
155mm M449	480m	480m
155mm M483	650m	650m
8-inch M404	485m	485m
8-inch M509	650m	650m

Values include a maximum wind submissile drift of 250 meters in a 50 knot wind.

Table 11-5. Submissile drift factors for ICM projectiles

WIND VELOCITY	ELEVATION	MAX RANGE DRIFT	MAX DEFLECTION DRIFT
50 knots	300 mils	250m	250m
50 knots	600 mils	150m	160m
50 knots	1150 mils	100m	100m
10 knots	300 mils	50m	50m
10 knots	600 mils	40m	30m
10 knots	1150 mils	20m	20m

Table 11-6. Artillery Cannon Firing Antipersonnel-type ("Beehive") Cartridges

CALIBER	DISTANCE X	DISTANCE Y
90mm Gun M377	2400m	2400m
90mm Gun M580	10600m	1200m
105mm Howitzer M546	7900m	1100m

Dimensions for Distance X are based on 15° quadrant elevation.

Table 11-7. Surface Danger Zone dimensions for the 14.5MM, M31 Field Artillery Trainer

Impact Area Condition	Range to Target	Maximum Ricochet Downrange(Area B)	Distance Lateral(Area A)
Soft soil ^{1,2,3}	100	470	75
	150	420	75
	200	375	75
	250	330	75
	300	305	75
	350	290	75
	400	285	75
	450	80	25
	500	80	25
	550	80	25
	600	80	25
	650	80	25
	700	80	25
	730	80	25
Medium soil ^{2,3,4,5}	100	490	75
	150	455	75
	200	410	75
	250	370	75
	300	355	75
	350	350	75
	400	350	75
	450	80	25
	500	80	25
	550	80	25
	600	80	25
	650	80	25
	700	80	25
	730	80	25
Macadam/Concrete ²	100	1345	120
	150	1310	135
	200	1265	145
	250	1215	195
	300	1165	205
	350	1120	245
	400	1070	250
	450	1020	285
	500	965	310
	550	910	310
	600	855	325
	650	790	315
	700	710	310
	730	590	280

¹The soft soil condition assumes the soil is loosened, raked, and essentially rock free for the top 6 inches.

²For macadam/concrete at all ranges and for soil when first impact is less than 450 meters, lateral dispersion is due to ricochet and occurs near maximum ricochet range. When the range is 450 meters or more, the projectile does not ricochet from soil; therefore, lateral dispersion is due to ballistics only and occurs near the center of impact.

³The presence of large rocks and boulders in the area may necessitate the use of the macadam/concrete danger zones as the worst case.

⁴The medium soil condition assumes the soil is essentially rock free and of medium hardness (cone penetrometer values less than 150 between 0 and 3 inches).

⁵Frozen soil, desert hard pan, and hard, dry soil are not considered medium soil and would represent a condition between medium soil and macadam/concrete. Use the more conservative dimension.

Chapter 12 Tank Gunnery

12-1. General

a. This chapter prescribes requirements for firing tank-mounted main guns, machineguns, and subcaliber training devices.

b. Surface danger zones in this chapter are established for the following tank, M551, and CEV mounted weapons.

- (1) Gun, 90mm.
- (2) Gun, 105mm.
- (3) Gun, 152mm (conventional ammunition).
- (4) 152mm SHILLELAGH missile.
- (5) 165mm CEV.

12-2. Safety program

a. Commanders.

(1) Unit commanders are responsible for safety during all phases of a firing exercise. They will select weapons-systems-qualified personnel (at least commissioned or warrant OIC) to assist them in discharging their safety responsibilities.

(2) The firing unit commander may appoint an RSO (with assistants as necessary) to act as the direct representative of the OIC. These personnel will be weapons-system qualified. Personnel detailed to perform OIC and range safety officer duties will be familiar with this regulation and installation range regulations and procedures and will have available on the range a copy of the TM appropriate to the firing vehicle.

b. Personnel detailed as OIC of tank firing ranges will be weapons-system qualified and E7 or higher. The OIC is responsible for safety and range operations during firing. The OIC will insure all firing personnel have been thoroughly briefed on range safety.

c. The RO will approve all surface danger zones or give to the OIC—

- (1) Surface danger zone showing all required data.
- (2) A listing of ammunition authorized to be fired.
- (3) Target locations.
- (4) Authorized firing hours.
- (5) A copy of the installation range regulations.

d. The RSO is the direct representative of the OIC of firing. The RSO is responsible to the OIC for insuring the adequacy of safety during firing.

e. The tank commanders (TCs) are responsible for the safe firing and operation of their tanks.

12-3. Firing requirements

The requirements in this chapter apply to the firing of tanks, M551, and CEV-mounted weapons.

a. The dimensions shown in table 12-1 and figures 12-1 and 12-2 provide for safe firing of tank cannon.

b. When tank firing ranges with less than the prescribed safety limits must be used, existing compensatory terrain features and offsetting control measures to be used will be thoroughly evaluated. A waiver will be obtained in accordance with paragraph 1-6 before firing on the reduced surface danger zone.

c. Either hard or soft targets may be used. When firing at less than the full width of the surface danger zone, the use of soft targets will reduce lateral dispersion.

d. The firing of tank weapons from the firing position at a target at the opposite side of the range is permitted. However, the limits of fire, combined dispersion and ricochet area, and Area A of the surface danger zone must have been adjusted to compensate for and accommodate such firing. (See fig 12-3.) On ranges that do not permit cross-range firing, inner safety markers will be used. Tanks right of center use left inner marker and right outer marker as their safety limits. Tanks left of center use right inner marker and left outer marker as their safety limits.

12-4. Surface danger zones for tank cannon

a. The surface danger zone (fig 12-1) provides for tank gun direct fire at fixed or moving ground targets from stationary tanks or from moving tanks with stabilized guns.

b. The dimensions given in figure 12-1 provide for firing at quadrant elevations of 5 degrees (89 mils) or less.

c. Total range distance includes horizontal range corresponding to 10 degrees (178 mils) quadrant elevation, an allowance for the maneuver area, and Area B. This total range distance will not be reduced for any condition of firing unless a waiver has been obtained.

d. The following measures will be taken to insure that tank cannons are not fired at quadrant elevations greater than 5 degrees (89 mils).

(1) Tank commanders will insure that all weapons are pointed into the impact area with an elevation at or less than the maximum authorized.

(2) Nonstabilized main tank armament will not be fired while the tank is moving. (This does not include machineguns.)

(3) Targets will be positioned so that the range and elevation of fire from the firing position to the target will not exceed 5 degrees (89 mils).

e. Dimensions shown in table 12-1 will be used to construct the surface danger zone.

12-5. SHILLELAGH

The surface danger zone (fig 12-4) applies to missiles

equipped with either HE or practice warheads, standard or extended range.

a. Dimensions shown in table 12-1 will be used to draw the surface danger zone.

b. Direct viewing of radiated energy from the transmitters presents a hazard to personnel. Those who enter the primary danger area before or after the firing of the SHILLELAGH missile should not view the transmitter from angles within 5 degrees of the beam axis.

c. Safety precautions to be taken when SHILLELAGH missiles are fired to reduce the exposure to a possible "fly-back" incident follow:

(1) Comply with safety requirements in AR 385-62.

(2) Modify the surface danger zone to provide an additional area 360 degrees, about 1500 meters radius, measured from a point 30 meters uprange on the line of fire.

(3) Keep the number of operating personnel and quantity of missile material to a minimum consistent with safe and efficient operations. Do not allow casual transient personnel within the surface danger area during firing. Properly locate and protect ready storage of SHILLELAGH HEAT missiles.

(4) Prefire test all missiles and vehicles (fire pulse) as specified by US Army Missile Command messages or local range directives.

(5) Additionally provide, for HEAT missile firings, a barricade revetment or sandbag protection, up to the level of the gun tube, in front of each firing vehicle to protect against a "fly-back" round impacting against the tank.

12-6. Surface danger zones for subcaliber tank gunnery devices

Surface danger zones will be constructed as shown in figure 6-1. The dimensions in table 12-2 for single-shot firing at 10 degrees (178 mils) or less super-elevation will be used. When coaxial or vehicle-mounted machineguns are fired in the automatic mode, the dimensions in table 6-1 will be used.

12-7. Grenade launchers

a. Surface danger zones for the M176, M226, and M239 grenade launcher are shown in figure 12-5.

b. Occupancy of the surface danger zone by unprotected personnel in the open is prohibited.

c. Dimensions shown in figure 12-5 are for illustrative purposes only. To aid in constructing surface danger zone on a 1:50,000 map for grenades launched from tanks, scribe a circle 75 meters in radius for the M239 and one 90 meters in radius for the M176/M226 launchers. All measurements are from the point of launch.

12-8. Weapons effect signature simulator (WESS)

Personnel without hearing protection will not be permitted closer than 25 meters from WESS systems.

12-9. Designation of firing status of tanks, M551s, and CEVs

a. *Static firing.* During daylight and good visibility, flags will be displayed by the firing vehicle. At night and during reduced visibility, lights will be displayed by the firing vehicle.

Color	Meaning
(1) Red	Tank engaged in firing, weapons must be pointed at the target area.
(2) Green	All tank weapons are clear and elevated. Any live ammunition in the tank is properly stowed.
(3) Yellow	Tank has malfunction. Yellow is used only in conjunction with red or green.
(4) Red and green	Tank is preparing to fire or the crew is performing a nonfiring exercise. Weapons are clear but not elevated.
(5) Red and yellow	Tank has a malfunction or misfire. Weapons are not clear and are pointed at the target area.
(6) Green and yellow	Tank has a malfunction. All weapons are clear.

b. *Firing on the move and battle runs.* Once a vehicle begins its battle run and passes the start fire line, all weapons are considered to be loaded and ready to fire. Flags or lights are not required to be displayed, but their use will provide a greater degree of control when more than one vehicle is firing on the move.

c. *Completion of firing.* When the firing has completed its battle run and the vehicle's weapons have been cleared and checked by the TC or RSO, it will move rear range and out from the firing area or maneuver box.

d. *Exiting the range.* The TC or the RSO will insure that the main gun is aligned within the envelope of the vehicle width when traveling off range on to roadways or tank trails.

12-10. Close support of ground troops in a live fire exercise

a. Fire overhead of unprotected troops by tanks, M551s and CEVs main guns is prohibited.

b. Tank, M551 and CEV main guns may be used to provide flanking fire if unprotected personnel remain out of the surface danger zone. The lateral secondary danger area, Area A, may be eliminated when firing practice ammunition with inert practice projectiles. *Exception:* Spotting charge projectiles or frangible projectiles (APFSDS) that may eject a hazardous fragment. When fragment-producing projectiles are fired, the normal surface danger zone separation will be re-

quired between the line of fire and the near flank or the supported unit (e.g., 15 degrees (267 mils) plus Area A distance).

Table 12-1
Dimensions for tank cannon (in meters) ¹
(See figs 12-1, 12-2, 12-3, and 12-4.)

Caliber	A ²	B ³	X	D ⁴ (Direct fire)
90mm Gun	600	600		550
105mm Gun	615	615		650
152mm Gun	715	715		675
165mm CEV	750	750		Note ⁵ 1,000
SHILLELAGH missiles				
Standard Range	Note ⁶	800	4400	700
Extended Range	Note ⁶	800	5400	700

Notes:

1. When firing antipersonnel cartridges at quadrant elevations of 10 degrees (178 mils) or less, see table 11-6 and figure 11-4 for surface danger zone requirements.
2. The lateral secondary area, Area A, may be eliminated when firing inert practice projectiles at soft targets except spotting charge or frangible projectiles (APFSDS) that may eject a hazardous fragment. Does not apply to the SHILLELAGH missile.
3. Area B is necessary to provide a buffer zone from hazardous fragments caused by high explosives or frangible projectiles (APFSDS) impacting near the far edge of the impact area; however, can be eliminated when firing inert practice projectiles. (This does not apply to the SHILLELAGH missile.)
4. Direct fire distances are those minimum required to protect unprotected personnel from hazardous fragments resulting from the firing of high explosives projectiles at hard or fragment-producing targets. When firing high explosive projectiles, as discussed above, at less than the prescribed safety distances between the gun and the target, the vehicle must be buttoned up. All other exposed personnel located at less than the prescribed safety distances from the target (coln D above) will be provided positive protection against fragments.
5. Hazardous fragments (those with an impact energy of 58 ft-lb or greater and with a density exceeding one per 600 sq ft) from the exploding 165mm HEP round may travel out to 1,000m in any direction from the point of detonation. During firing, the vehicle must be buttoned up and all observers within 1,000 meters of the target area must be provided positive protection against fragments.
6. Area A is determined by construction of the diagram.

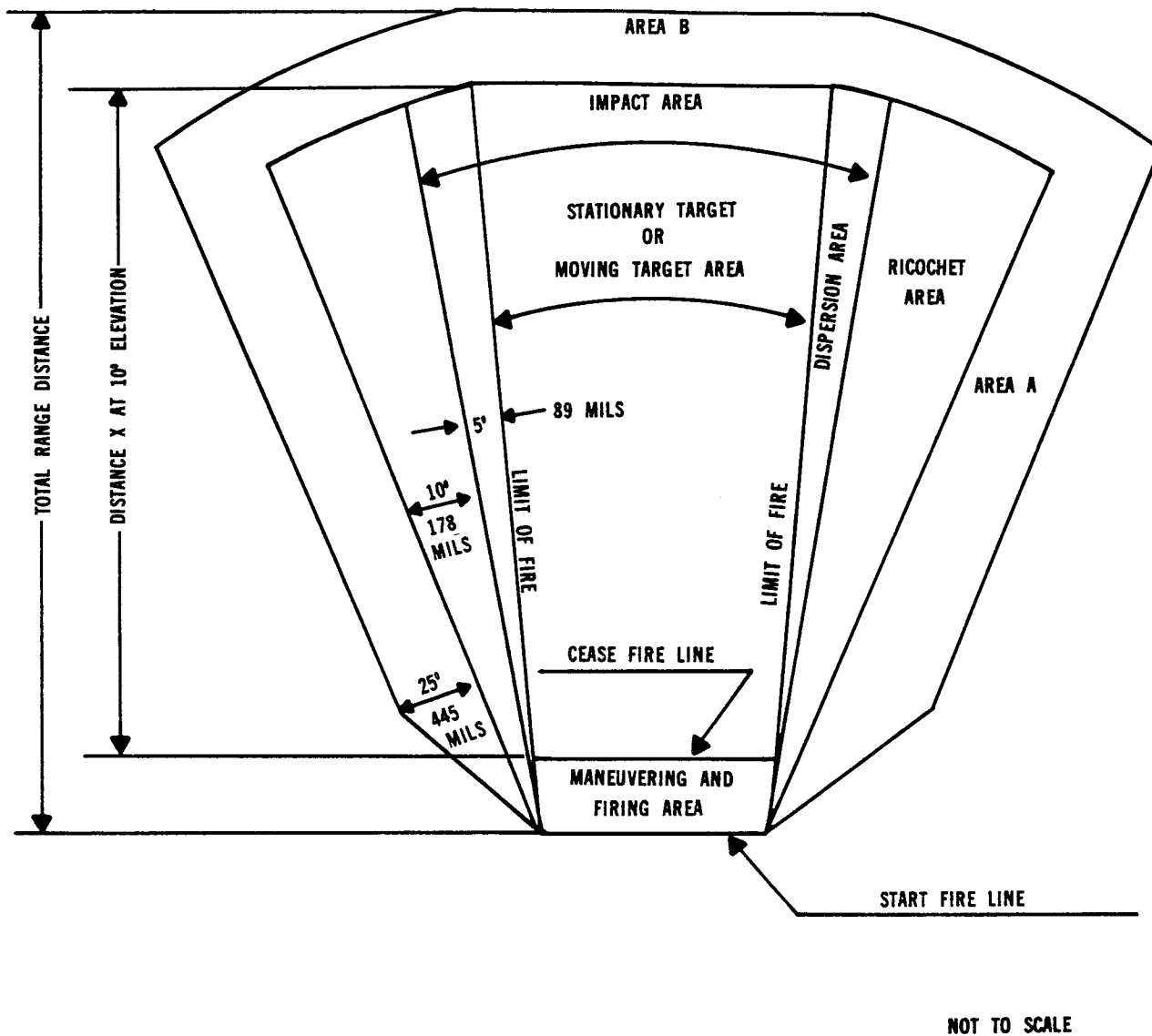


Figure 12-1. Surface danger zone for one or more tanks firing on the move

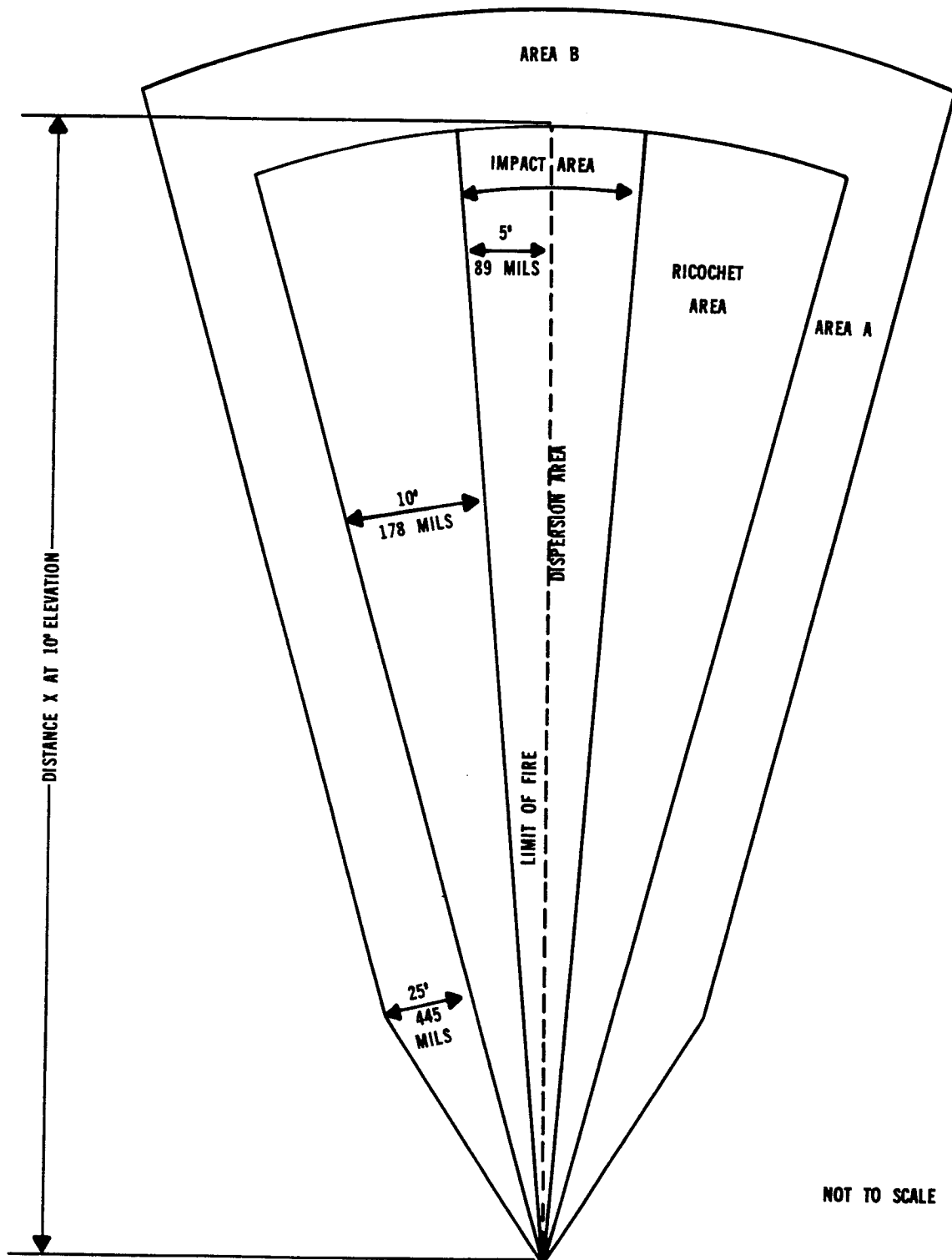
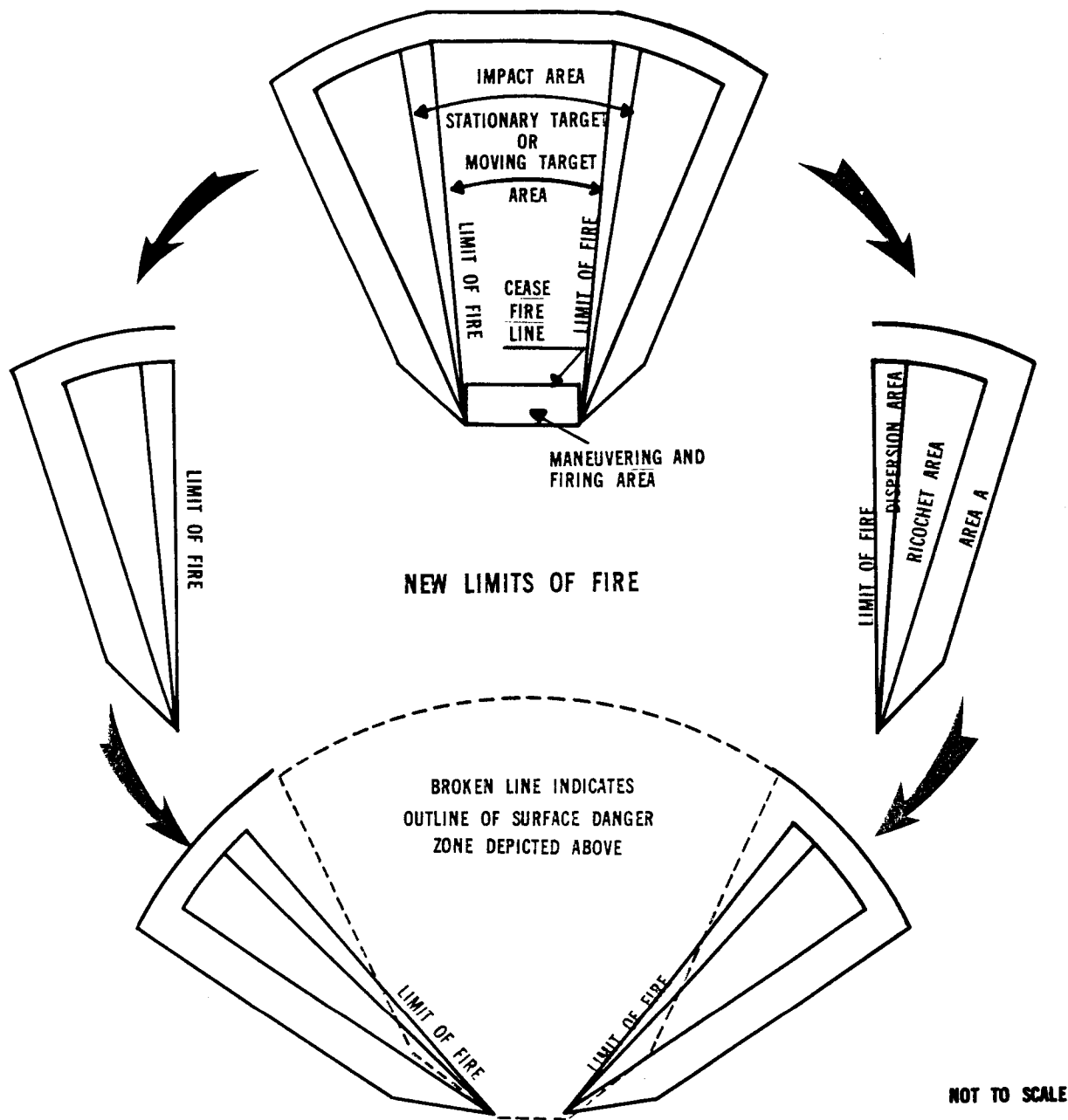
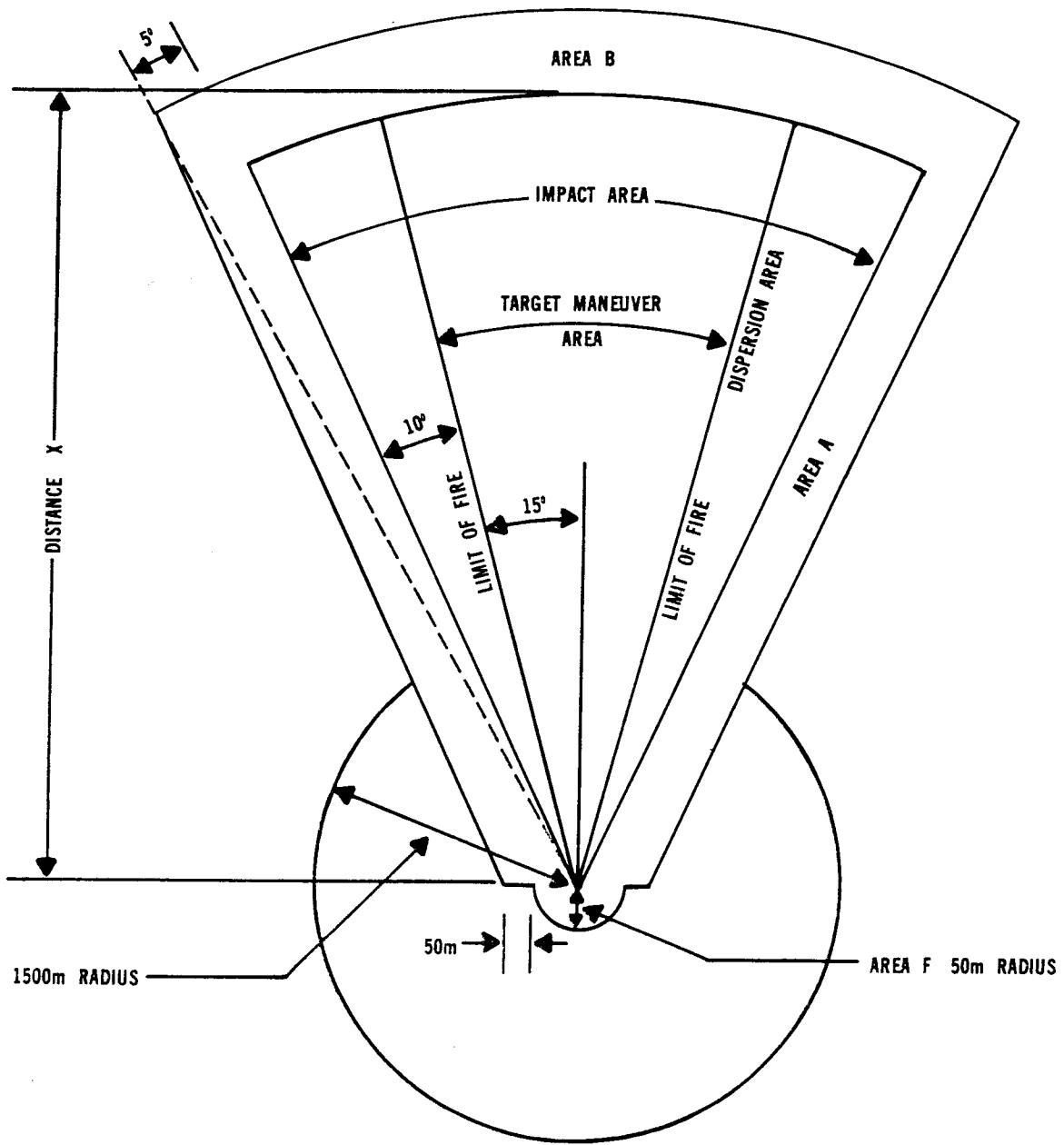


Figure 12-2. Surface danger zone for single tank cannon direct fire from a static firing position



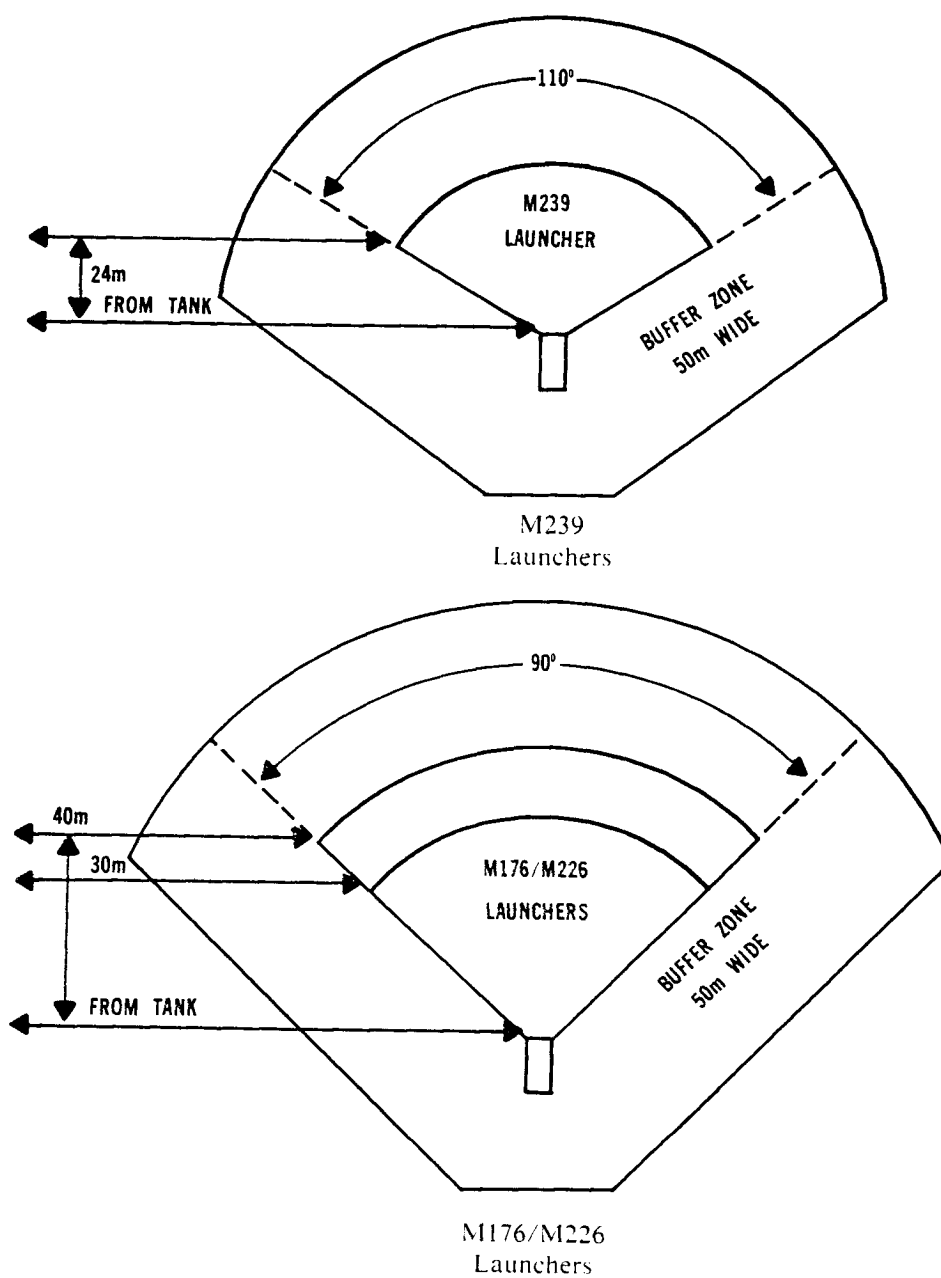
1. Establish new right and left limits of fire to accommodate desired gun-target engagements.
2. Add dispersion, ricochet and Area A requirements to new limits of fire.
3. Modify impact and target areas in accord with new limits of fire.
4. Extend and connect Area B to original surface danger zone.

Figure 12-3. Surface danger zone to modify a range to permit cross-firing



NOT TO SCALE

Figure 12-4. Surface danger zone for firing SHILLELAGH missiles at moving targets (See table 12-1.)



NOT TO SCALE

★ Unprotected personnel not permitted in surface danger zone.

Figure 12-5. Surface danger zone for tank grenade launchers

Table 12-1. Tank Common

(See figs. 12-1, 2, 3, & 4)

Caliber	Note ²	Note ³	Note ¹ Dimensions of areas in meters	
			X	D (Direct Fire)
90mm Gun	600	600	--	550
105mm Gun	615	615	--	650
152mm Gun	715	715	--	675 ⁵
165mm CEV	750	750	--	Note ⁵ 1,000
SHILLELAGH missiles				
Standard Range	Note ⁶	800	4400	700
Extended Range	Note ⁶	800	5400	700

¹When firing antipersonnel cartridges at quadrant elevations of 10 degrees (178 mils) or less, see table 11-6 and figure 11-4 for surface danger zone requirements.

²The lateral secondary area, Area A, may be eliminated when firing inert practice projectiles at soft targets except spotting charge or frangible projectiles (APFSDS) that may eject a hazardous fragment. Does not apply to the SHILLELAGH missile.

³Area B is necessary to provide a buffer zone from hazardous fragments caused by high explosives or frangible projectiles (APFSDS) impacting near the far edge of the impact area, however, can be eliminated when firing inert practice projectiles. (Does not apply to the SHILLELAGH missile.)

⁴Direct Fire distances are those minimum required to protect unprotected personnel from hazardous fragments resulting from the firing of high explosive projectiles at hard or fragment-producing targets. When firing high explosive projectiles as discussed above, at less than the prescribed safety distances between the gun and the target, the vehicle must be buttoned up. All other exposed personnel located at less than the prescribed safety distances from the target (col D above) will be provided positive protection against fragments.

⁵Hazardous fragments (those with an impact energy of 58 ft-lb or greater and with a density exceeding one per 600 sq ft) from the exploding 165mm HEP round may travel out to 1,000m in any direction from the point of detonation. During firing, the vehicle must be buttoned up and all observers within 1,000 meters of the target area must be provided positive protection against fragments.

⁶Area A is determined by construction of the diagram.

Table 12-2. Surface Danger Zone Requirements For Subcaliber Tank Gunnery Devices

Caliber	Device	A	B	X at 10 degrees (178 mils) or less
.22LR	DVC-D17-53, .22 cal inbore	100m	--	1,075m
5.56mm rifle	DVC-D17-87, Brewster	100m	--	2,250m
7.62 Coax MG	DVC-D17-87, Brewster (single-shot)	100m	--	3,100m
Cal .50MG	DVC-D17-88 Telfare (single-shot)	100m	--	4,050m
Cal .50Spotter Round	90mm in-bore	100m	--	3,600m
	105mm in-bore	100m	--	3,600m
20mm HE-I-T	Riley in-bore	300m	400m	4,438m

Surface danger zones will be constructed as shown in figure 6-1 using the above dimensions for single-shot firing at 178 mils or less super-elevation. When coaxial or vehicle-mounted machine guns are fired in the automatic mode, the dimensions shown in table 6-1 will be used.

Chapter 13 Aerial Gunnery

13-1. Safety measures for firing exercise

This chapter provides for the safe firing of guns, rockets, and missiles from Army rotary-wing aircraft. The provisions of this chapter apply to Marine Corps rotary-wing aircraft weapon systems when other US Navy/Marine Corps or local range area regulations are not applicable. The following general standards will be included in the planning for firing exercises.

a. Qualified instructor pilots (IP) or unit trainers having immediate access to positive control of the aircraft and weapon system being fired will accompany pilots and gunners who are not qualified and current in both the aircraft and the weapon system. Unit trainers may only be used when fully qualified IPs are not available and delay of training would adversely affect unit training/readiness. In all cases, final qualification check rides will be administered by fully qualified IP or standardization instructor pilot (SIP).

b. Pilots and gunners are qualified when they have—

(1) Successfully completed an approved qualification course or qualification or transition training in accordance with the applicable Aircrew Training Manual in the aircraft and weapon system being fired.

(2) Demonstrated flight and weapon proficiency to a designated IP in the applicable aircraft and weapon system.

c. Pilots and gunners will be familiar with the impact area, firing limits, danger zones, and safety regulations for each firing range.

d. The OIC will be responsible for—

(1) All aspects of safety in the firing unit and on the assigned firing range. The OIC will appoint assistants. They may include, but are not limited to, the RCO, aviation safety officer (ASO), RSO, IP, and the radio controller.

(2) Insuring that the firing aircraft are properly located within the surface danger zone, correctly oriented in the target direction and safe to fire. When firing is conducted in such a manner or in areas where the OIC cannot supervise the firing from the ground, then the OIC, or assistant, should be airborne in a control aircraft. When the firing is conducted with a scout aircraft, it may be used to verify that the firing aircraft is properly oriented and safe to fire.

e. Communications will be maintained at all times between the aircraft, the OIC, and the RCO at the firing range. Firing will be suspended immediately on loss of communications.

f. The airspace routing to be used by armed aircraft

flying from the ammunition loading site to the firing range, the range flight pattern, and return route to the loading site will be plotted on a map or chart. The course will be carefully selected so that accidental firing at any point on the course will present minimal risk to life and property.

g. Commanders will insure that all crash rescue personnel will be knowledgeable of the safety precautions to be used around armed aircraft and the danger of movement in impact areas.

13-2. Range requirements

For firing from hover, a surface danger zone will be superimposed over the gun-target line at each firing point. For firing on a running fire course, surface danger zones will be superimposed over each anticipated gun-target line along the course. These surface danger zones will begin at the safe arm line and move along the course to each anticipated firing point.

a. A range may contain several different hover firing points or a running fire course where multiple aircraft can fire at the same time. The resultant surface danger zone will not be a single conical shaped form, but will be irregular since it will be formed from a number of individual surface danger zones. When multiple aircraft are firing at the same time, controls will be established to insure that one aircraft will not enter the surface danger zone of another firing aircraft.

b. Facilities, materiel, and personnel will not be located in the surface danger zone during firing unless positive protection is provided from a direct hit of the weapon being fired. Personnel will not be permitted in the surface danger zone when firing shaped charges or fragmenting HE sub-munition warheads.

c. Aircraft weapons will be loaded or unloaded in an approved area. The area will provide a surface danger zone forward of the weapon or where the hazards of accidental firing can be contained (by impacting into a natural or manmade barrier). The master arm switch must be placed in the safe position before leaving the surface danger zone. Promptly landing the aircraft after each firing phase or mission, the engines will be shut down, the aircraft statically grounded, and the weapon system's switches turned off. The weapons will then be inspected for any remaining ammunition. Commencing with the outermost weapons, each weapon will be inspected and cleared of ammunition at the end of the firing.

d. During firing training, shutting down the aircraft engine may not be realistic or possible. When training requirements dictate, commanders (battalion, squadron, or higher) may authorize loading and unloading of

ammunition from aircraft while the engines are running. This will be done if—

- (1) All personnel have been briefed on the increased risk before the operation.
- (2) Necessary procedures and precautions have been established to prevent accidental firing of weapon systems or injury to personnel.

13-3. Firing requirements

a. When firing is being conducted by pilots and gunners not qualified and current in both the aircraft and the weapon system, ground markings are required for—

- (1) The aircraft firing positions.
- (2) Range limits.
- (3) Arming/start fire line.
- (4) Disarm/cease fire line.
- (5) No-fly line.
- (6) Right and left limits of fire.
- (7) The target area.

b. When firing is done by qualified and current pilots and gunners, ground markings are required for the firing position and the cease-fire line only. Additional ground markings may be used at the discretion of the commanding officer or the OIC.

c. Before the start of firing, the aircraft crew will be informed of the location of the firing position, the range limits, start line, cease-fire line, right and left limits of fire, and the target and emergency range landing area.

d. All ground markings will be visible both day and night from the firing control and scout aircraft. Unless night vision devices are used, targets must be illuminated at night by either artificial or natural (moon) light sufficient for positive target identification.

e. Weapon systems firing circuits will be checked in accordance with the appropriate aircraft “-10” series manual before each firing phase and prior to loading of ammunition. External weapon circuit checks will not be performed once the ammunition is loaded on board the aircraft.

f. If the weapon malfunctions, possible cook-off, or emergencies involving the weapon system, the pilot will proceed to one of the following areas—

(1) A predesignated approved range landing area that provides a surface danger zone in front of the weapon.

(2) A natural or manmade barrier to safely contain an accidental functioning of the weapon.

g. If an aircraft malfunctions, with weapon system loaded, the pilot will proceed to a preselected approved landing area commensurate with the type of malfunction. The crew will insure all personnel remain clear of the aircraft until qualified personnel have unloaded the weapon system.

13-4. Aerial gunnery

This paragraph provides for the safe firing of the 7.62

machinegun, .50 caliber machinegun, 20mm cannon, 30mm cannon, and 40mm grenade launcher from Army rotary-wing aircraft.

a. Use table 13-1 and figure 13-1 as the basis for establishing the surface danger zone.

b. Areas A and B, in accordance with table 13-1, are required if the projectile has an explosive warhead. If not, these areas may be deleted.

c. For door gunnery ranges, the values for distance X are the same. Student firing of door gunnery exercises will be supervised by weapon-system-qualified personnel appointed by the OIC.

d. Maximum altitude when firing will not exceed 2000 feet above ground level (AGL). The elevation of the weapon systems will be 5 degrees or less when measured in reference to the horizontal plane.

e. The target area is determined by the right and left limits of fire. It may begin at any point providing that the minimum safe slant-range distance for the weapon being fired is maintained from aircraft to point of impact. The target area will end at a distance equivalent to two-thirds of distance X, which is to be measured from the cease fire line to the end of the target area.

13-5. Aerial rocketry

This paragraph provides for the safe firing of the 2.75-inch folding fin aerial rocket (FFAR) weapon system from Army rotary-wing aircraft for hover and running fire.

a. Use table 13-2 and figures 13-2 and 13-3 as the basis for establishing the surface danger zone.

b. All projectiles must impact within the designated impact area.

c. The target area is determined by the right and left limits of fire. It may begin at any point beyond the start-fire line provided the minimum safe slant-range distance for the weapon being fired is maintained from the aircraft to the point of impact. The distance from the far edge of the target area to the near edge of Area B will be at least 2000 meters for all firing.

d. The minimum distance from the cease-fire line or disarm line to the near edge of Area B will be distance X.

e. The effects of air density and wind may alter the trajectory of a rocket and cause range and deflection errors. Troop training operations being conducted in conjunction with aerial rocket firing should be suspended if winds or gusts exceed 30 knots.

f. The procedures for grounding, loading, and unloading of rockets are in the appropriate launcher technical manuals.

g. Values in table 13-2 may be used for ground-to-ground firing on launch platforms other than aircraft (e.g., trucks, jeeps, armored personnel carrier).

h. The surface danger zone is depicted for a point firing only. For firing from various points or a running

fire course, a surface danger zone must be superimposed at each possible point of launch at each intended target.

13-6. Aerial missilery

a. Safe firing of the TOW antitank guided missile system from Army rotary wing-aircraft.

(1) The surface danger areas for the TOW missile subsystem are depicted in figure 13-4 and table 13-3. The surface danger zone is to be used for all airborne firings from US Army helicopters. Since there is no provision for command destruct by a safety officer, the surface danger zone is based on the maximum ballistic range of the missile.

(2) The surface danger zone consists of the target maneuver area, impact area, and Areas A, B, and F. The entire surface danger zone will be cleared of all personnel, except those directly associated with the firing, before a missile is fired. The TOW missile will not be fired at manned target vehicles.

(3) The target maneuver area is established by extending lines from the launch point 8 degrees each side of the line of fire. If the target is stationary, the target maneuver area may be eliminated.

(4) The impact area is established by extending lines from the launch point, 38 degrees each side of the line of fire. The impact area is adequate to contain the blast pressures and launch motor debris under normal conditions.

(5) Area F is the area in a semicircle immediately to the rear of the launcher. It is expected to contain the blast pressures and launch motor debris of a normal functioning motor.

(6) The TOW missile should not be fired from any range position that will allow the guidance wires to contact electrical power lines.

(7) After each firing mission, the range will be cleared as much as possible of all guidance wires that would present a hazard to helicopters.

(8) The surface danger zone is depicted for a point firing only. For firing from various points or a running fire course, a surface danger zone must be superimposed at each possible point of launch at each intended target.

b. Safe firing of the SS-11 anti-tank guided missile (ATGM) from a UH-1B/C/M rotary-wing aircraft.

(1) The surface danger zone shown in figure 13-5 represents the safety boundaries for controlled range firing of the SS-11 (M-22) ATGM system mounted on the UH-1B/C/M rotary-wing aircraft.

(2) An RSO should be positioned at a safe vantage point. The RSO should maintain constant communication with the gunner in the helicopter.

(3) Range markers visible to the firing aircraft should be set at the launch point and on both sides of the line of fire as noted in figure 13-5.

(4) The gunner will fire only after clearance from the OIC or the RCO.

(5) The entire surface danger zone will be cleared of all personnel before firing the missile.

(6) If a missile equipped with a high explosive warhead fails to detonate on impact, the fuze is, in all probability, armed and the missile is extremely dangerous. Under these conditions, the missile must not be moved. The slightest movement could cause the warhead to detonate. The missile should be destroyed in place by qualified EOD personnel.

(7) The SS-11 (M-22) wire guided missile should not be fired from any range position that will allow the guidance wires to contact electrical power lines either during normal trajectory or as a result of erratic trajectory that may be caused by malfunctions.

(8) The surface danger zone is depicted for a point firing only. For fire from various points or a running fire course, a surface danger zone must be superimposed at each possible point of launch at each intended target.

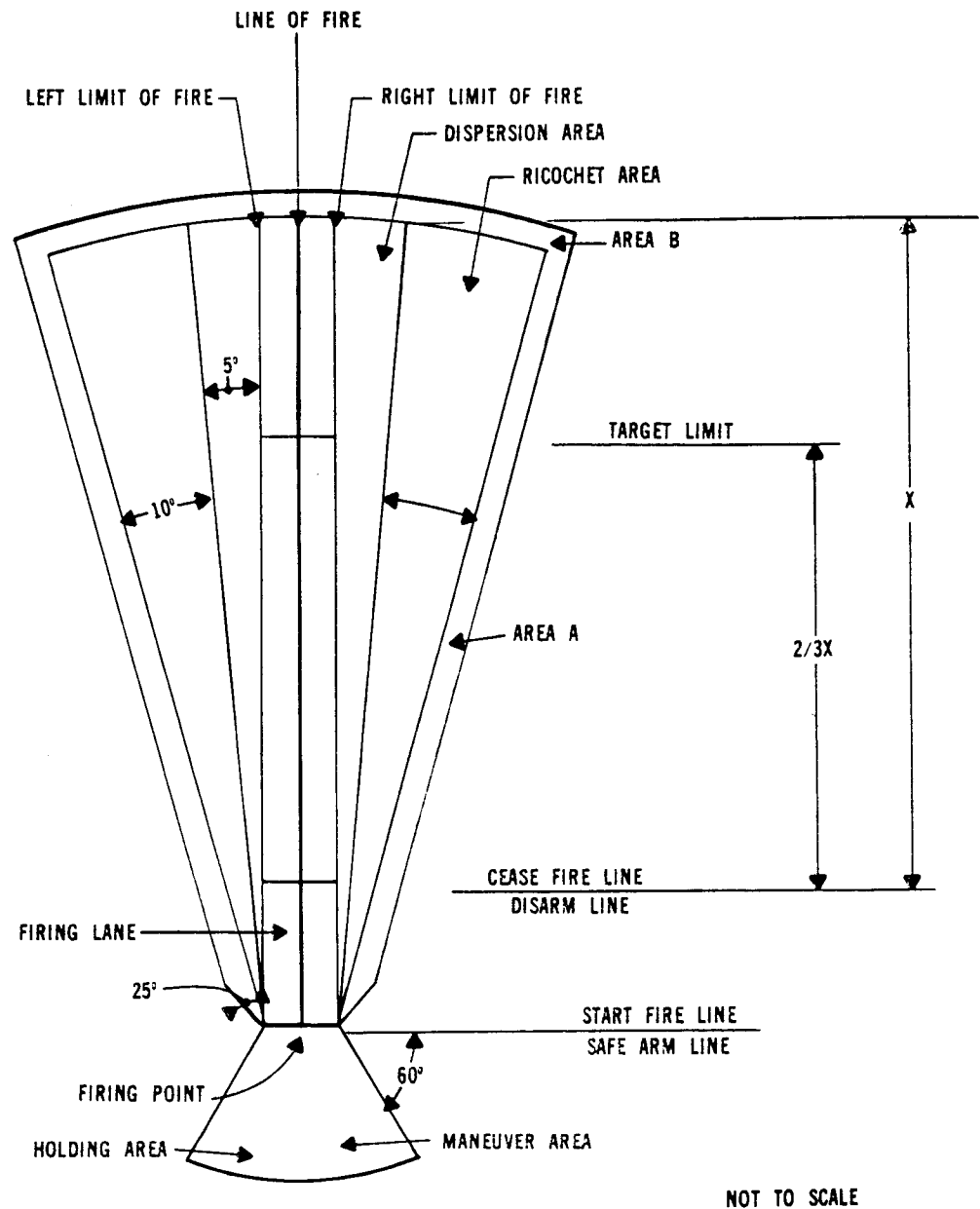


Figure 13-1. Surface danger zone for firing aerial guns at ground targets

TABLE 13-1. Surface danger zone dimensions for Aerial Gunnery. This table is to be used for firing aircraft mounted weapon systems. Maximum altitude will not exceed 2000 feet AGL when the following distances are used. Dimensions given are for stowed or flex mode firing and door gunnery firing. All dimensions are in meters.

Weapon	A	B	X
7.62 machine gun	NR	NR	3200m
Cal. 50 Machine Gun (M2 Cartridge)	NR	NR	5100m
20mm systems	165m	165m	4600m
30mm Systems	165m	165m	3300m
40mm system (grenade)	165m	165m	2100m

Table 13-2. Surface Danger Zone Dimensions For Aerial Fired Rockets

<u>Hover at altitude less than 10 meters AGL</u>							
Angle of launch ¹ in degrees	A	B	X ³	Angle of launch ¹ in degrees	A	B	X ³
4	300m	300m	3000m	18	300m	300m	6900m
6	300m	300m	3000m	20	300m	300m	7100m
8	300m	300m	4600m	22 ²	300m	300m	7400m
10	300m	300m	5200m	24 ²	300m	300m	7600m
12	300m	300m	5800m	26 ²	300m	300m	7800m
14	300m	300m	6200m	28 ²	300m	300m	8000m
16	300m	300m	6600m	30 ²	300m	300m	8200m
<u>Hover at altitude greater than 10 meters AGL</u>							
Angle of launch ¹ in degrees	A	B	X ³	Angle of launch ¹ in degrees	A	B	X ³
0	300m	300m	3000m	16	300m	300m	7100m
2	300m	300m	3000m	18	300m	300m	7300m
4	300m	300m	3600m	20	300m	300m	7500m
6	300m	300m	5000m	22	300m	300m	7700m
8	300m	300m	5600m	24	300m	300m	7900m
10	300m	300m	6100m	26	300m	300m	8000m
12	300m	300m	6500m	28	300m	300m	8300m
14	300m	300m	6800m	30	300m	300m	8500m
<u>Running fire at 90 knots</u>							
Angle of launch ¹ in degrees	A	B	X ³	Angle of launch ¹ in degrees	A	B	X ³
2	300m	300m	3700m	18	300m	300m	7600m
4	300m	300m	4600m	20	300m	300m	7800m
6	300m	300m	5300m	22	300m	300m	8000m
8	300m	300m	5900m	24	300m	300m	8200m
10	300m	300m	6400m	26	300m	300m	8300m
12	300m	300m	6800m	28	300m	300m	8400m
14	300m	300m	7100m	30	300m	300m	8500m
16	300m	300m	7400m	32	300m	300m	8700m

Angle of launch release is computed as follows:

$$\frac{\text{Launcher QE in Mils}}{17.7} + \text{Aircraft pitch in Degrees} = \text{Launch Angle in Degrees}$$

Examples: $\frac{123 \text{ mils}}{17.7} + -4^{\circ} =$

$$7^{\circ} + -4^{\circ} = 3^{\circ} \text{ angle of launch}$$

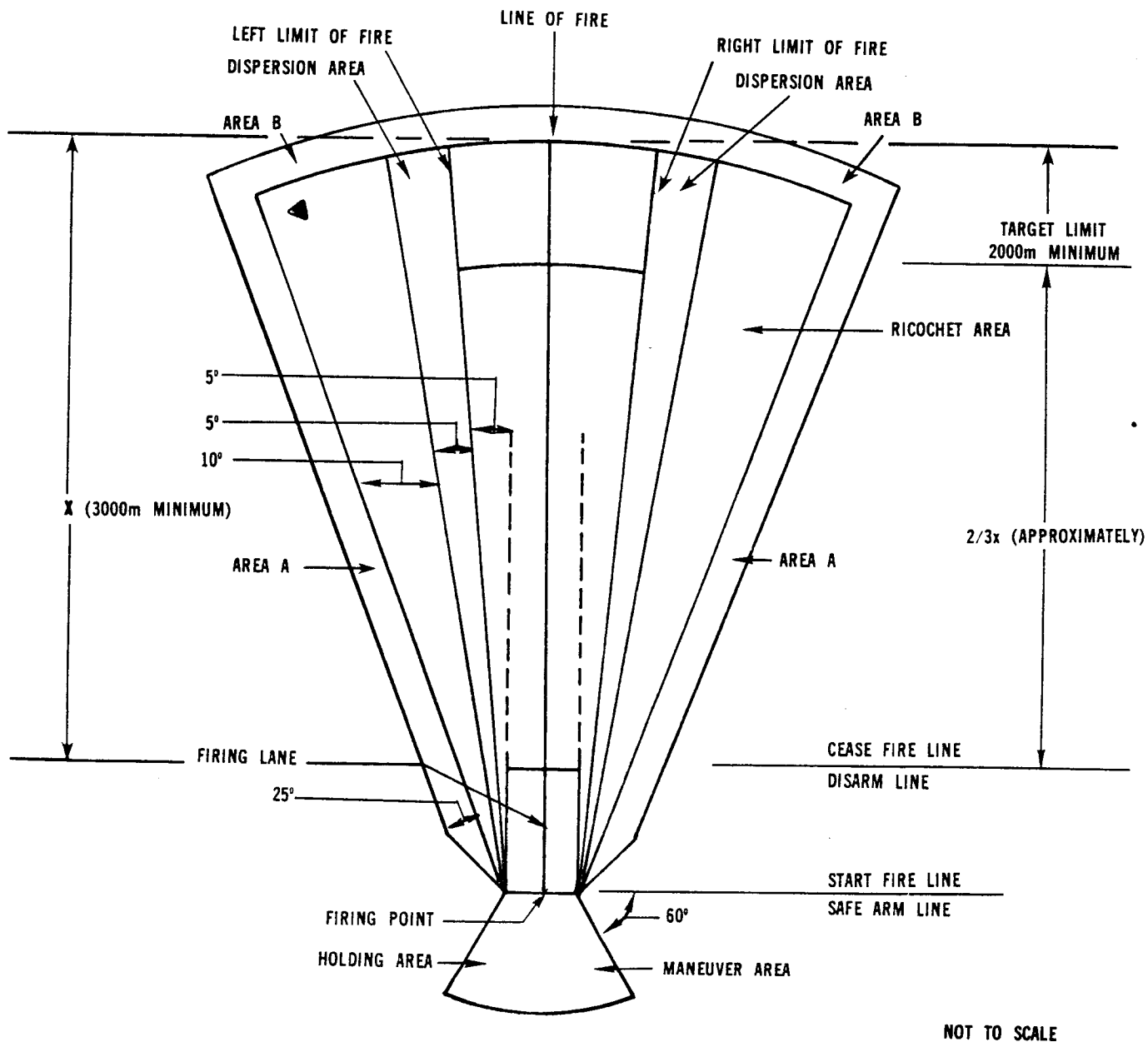
$$\frac{103 \text{ mils}}{17.7} + 2^{\circ} =$$

$$6^{\circ} + 2^{\circ} = 8^{\circ} \text{ angle of launch}$$

Maximum launcher QE shall not exceed 160 mils.

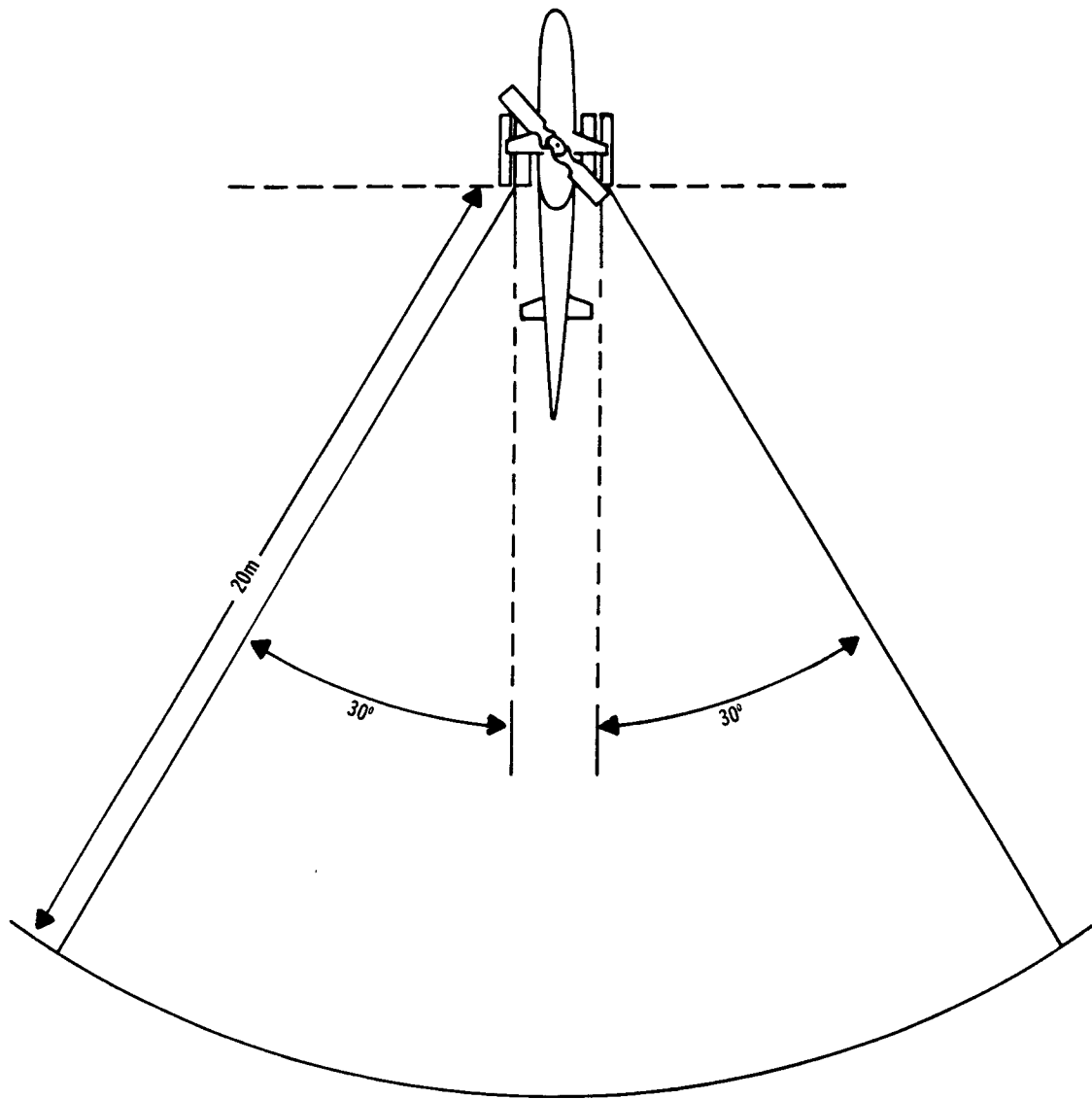
1. Angle of launcher at launch release relative to the horizontal plane.
2. This angle of launch not recommended at a hover below 20 feet AGL.
3. Maximum range of 2.75 rocket with MK40 motor is 9,000 meters. Maximum range with MK66 motor is 12,000 meters. 3,000 meters is the minimum distance to be used for distance X.

15 October 1983



Normal vertical danger zone with the parameter of Table 13-2 is 5000 feet AGL. The length and width of the firing lane will be determined by the OIC, minimum recommended width is 50 METERS.

Figure 13-2. Surface danger zone for firing aerial rocketry at ground targets



NOT TO SCALE

Figure 13-3. Rear blast area for hover firing and loading of aerial rockets

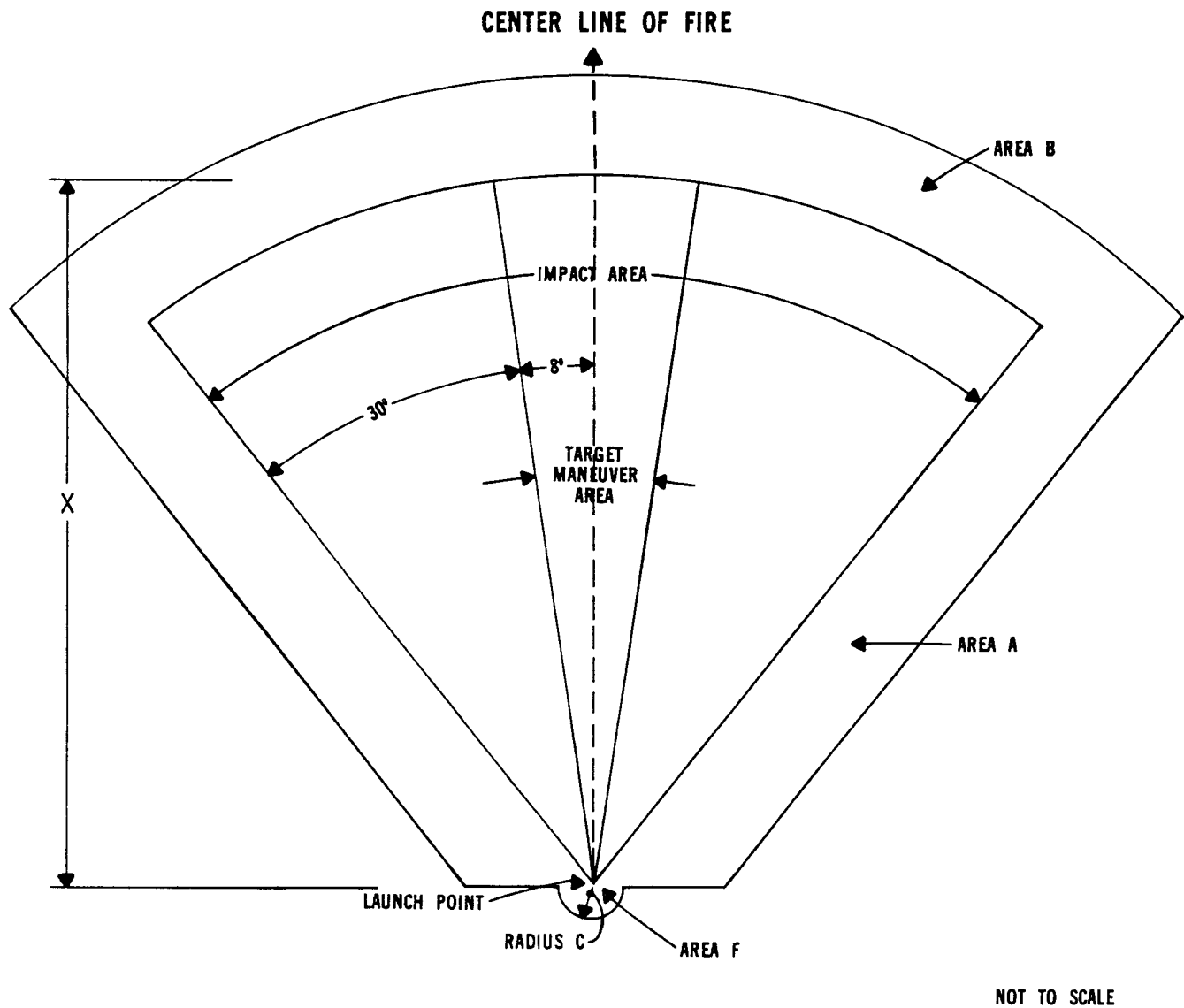


Figure 13-4. Surface danger zone TOW missile/aerial firing

Table 13-3. Aerial TOW missile surface danger area dimensions in accordance with Helicopter Flight Parameters

Airspeed (knots)	Hover	Hover-50	100	100	150
Altitude (feet)	0-50	50-100	50-100	500	1000
Distance X (meters)	4500	4700	4900	5100	5400
Radius C (meters)	100	200	200	200	200
Area A (meters)	750	750	750	750	750
Area B (meters)	750	750	750	750	750

1. Areas A and B may be reduced to 100 meters for practice missiles with inert warheads.
2. Surface Danger Zone applies to both standard TOW Missile and extended range TOW Missile. No increase in dimensions is necessary for extended range TOW Missile.

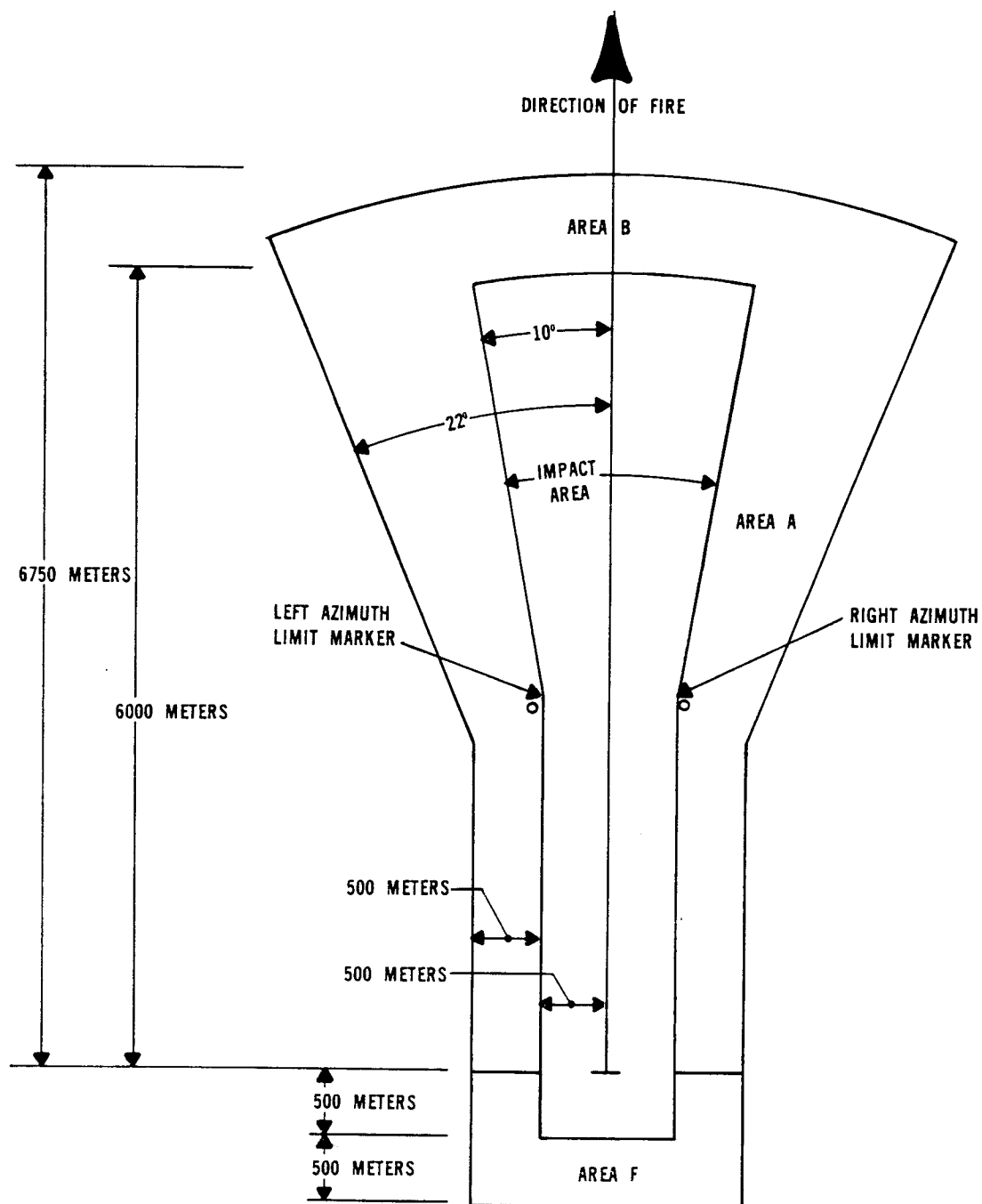


Figure 13-5. Surface danger zone for aerial firing of the SS-11 ATGM at ground targets from helicopter in forward flight

Chapter 14

Air Defense Weapons

14-1. Safety measures for air defense automatic weapons

This chapter covers air defense automatic weapons in their use against aerial targets (fig 14-1) and in a ground support role (fig 14-2). When used for ground support, also comply with chapter 16 and the specifications in figure 14-2.

a. Do not locate troops within the surface danger zone while firing at aerial targets.

b. Permit firing at targets towed by manned aircraft under the following provisions:

(1) Do not allow the towing aircraft in the airspace above the surface danger zone unless the weapon has been mechanically disenabled to fire.

(2) Limit this training technique to the VULCAN 20mm gun, the M42 twin 40mm gun, and the M55, quad 50 machinegun.

(3) Prohibit radar tracking and gun control in azimuth and elevation.

c. Provide minimum overhead cover (FM 5-15) for personnel required to be in the surface danger zone at points other than at the battery positions.

d. Base the surface danger zone on the full projectile trajectory to ground. Reduction of the surface danger zone is not permitted for self-destruction of ammunition or function of ammunition on the aerial target.

e. The dimensions of the impact area depend on the nature of planned firing. The impact area will *not* be smaller than the 5-degree dispersion area beyond each side of the right and left limit of fire. The minimum dimensions of the impact area are based on standard conditions. No provision is made for errors caused by non-standard conditions or gross errors in laying the weapons.

f. The surface danger zone (fig 14-1) does not provide for impacts caused by loss of target missile control or erratic flight of a damaged target missile.

g. The using unit will designate an RSO to insure compliance with all safety regulations.

14-2. Conduct of firing

a. Do not fire target courses (registration or firing of check rounds) during troop demonstrations or any time when spectators are present. This restriction applies only to registration firing.

b. Insure all weapons firing at aerial targets are on a single firing line at predesignated firing positions with field of fire, troop location, and range limitations. Also insure they are properly identified and marked with visi-

ble indicators.

c. Fire only one course at one time within the surface danger zone established for the weapon.

d. Do not exceed 65 degree quadrant elevation during any firing.

e. All personnel, except those on the firing weapon, the OIC, and safety personnel will remain behind the firing line. Move all vehicles, except firing units on the firing line, to a designated area at least 65 meters behind the firing line.

f. The surface danger zone for firing at aerial targets is shown in table 14-1 and figure 14-1.

g. Insure distance X (figure 14-1) is at least the maximum range at which the weapon will be fired or the range corresponding to a quadrant elevation of 15 degrees when the elevation of fire is 15 degrees or less.

h. Stake the limits of fire for each weapon on an established firing line. The assigned RSO will insure that no firing is conducted outside these limits.

i. When the 20mm M163 VULCAN system is used in ground support exercises, observe the safety requirements below:

(1) Fire only target practice or target practice with tracer rounds.

(2) Assemble the arm-safe switch to the arming connector in the distribution box. Control all firing by external operator.

(3) Fire from preselected positions with vehicle in halted position and troops on the same line or to the rear of the weapon at all times.

(4) During live-fire exercise travel, place the weapon at maximum elevation and remain in this position until the vehicle is halted and ready to fire from designated positions. During travel, other than an exercise, place the weapon in travel lock position, disconnect the arming connector or arm-safe switch, and clear the weapon.

(5) Insure elevation and traverse limit switches are operable and properly adjusted at all times. Firing must be within controlled limits.

14-3. Target missiles

a. Determine flight patterns and pertinent data on new target missiles before flight.

b. Launch targets in a direction leading away from roads, highways, and railways in the immediate vicinity. Do not fly targets closer than 500 meters horizontal distance from public traffic routes (public street, road, highway, navigable stream, or passenger railroad).

c. Fly normally only during daylight hours. If flights are conducted between sunset and sunrise, anticollision lights (Grimes lights) and red and green navigation lights are required. Locate properly all lights in accord-

ance with standard aircraft lighting requirements. Immediate recovery of the aerial target will begin if any lights fail after launch.

d. Establish a warning system to warn personnel if target control is lost.

e. Contain all aerial target flights within the restricted airspace assigned to the installation. Coordinate exceptions with the Federal Aviation Administration at least 90 days in advance.

f. Require radar surveillance of restricted airspace used for aerial target flights. Exceptions to this requirement are permitted only when aerial targets are flown within sight of the target controller. In this case, post a minimum of two air observers, provided with a means

of communicating directly with the target controller, to observe for manned aircraft penetration of the airspace.

g. For the ballistic aerial target system, follow the safety and surface danger zone requirements in chapter 5.

h. When target control is lost, the controller will immediately report the loss to the OIC and RSO. The air guards will note the last position of the target missile. Depending on the location of the last position of the target missile, notify agencies having control of the surface or included ground impact area. The RSO will notify the agency responsible for control of forest fires and will institute recovery procedures.

Table 14-1 Antiaircraft weapons
(See fig 14-1.)
Dimensions of areas in meters

Caliber	A	B	C ¹	Distance X
Small arms.	100	100	100	See table 6-1
20mm guns.	300	400	600	5000m ²
30mm guns.	300	400	600	4100m
40mm guns.	300	400	600	9800m

Notes:

1. This column represents minimum aerial target engagement distances when personnel at the firing position are unprotected.
2. When firing the 20mm, M139 system, distances X will be increased to 5800m.

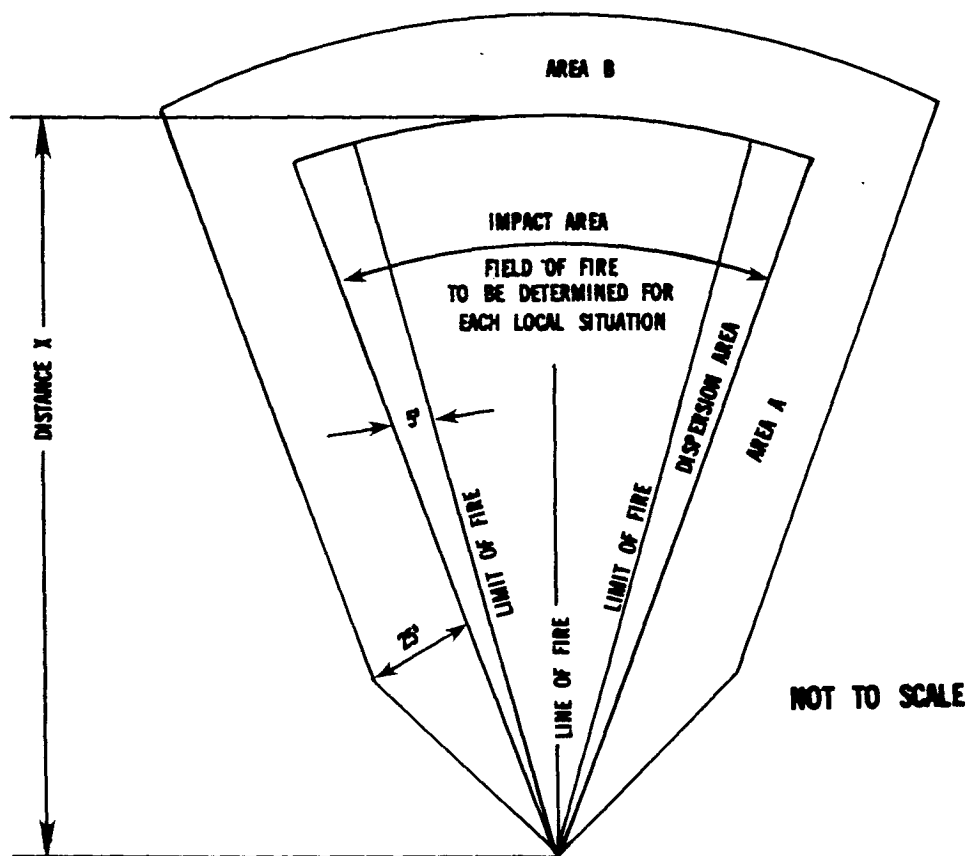


Figure 14-1. Surface danger zone for air defense weapons (See tables 6-1 and 14-1 for weapons firing at aerial targets.)

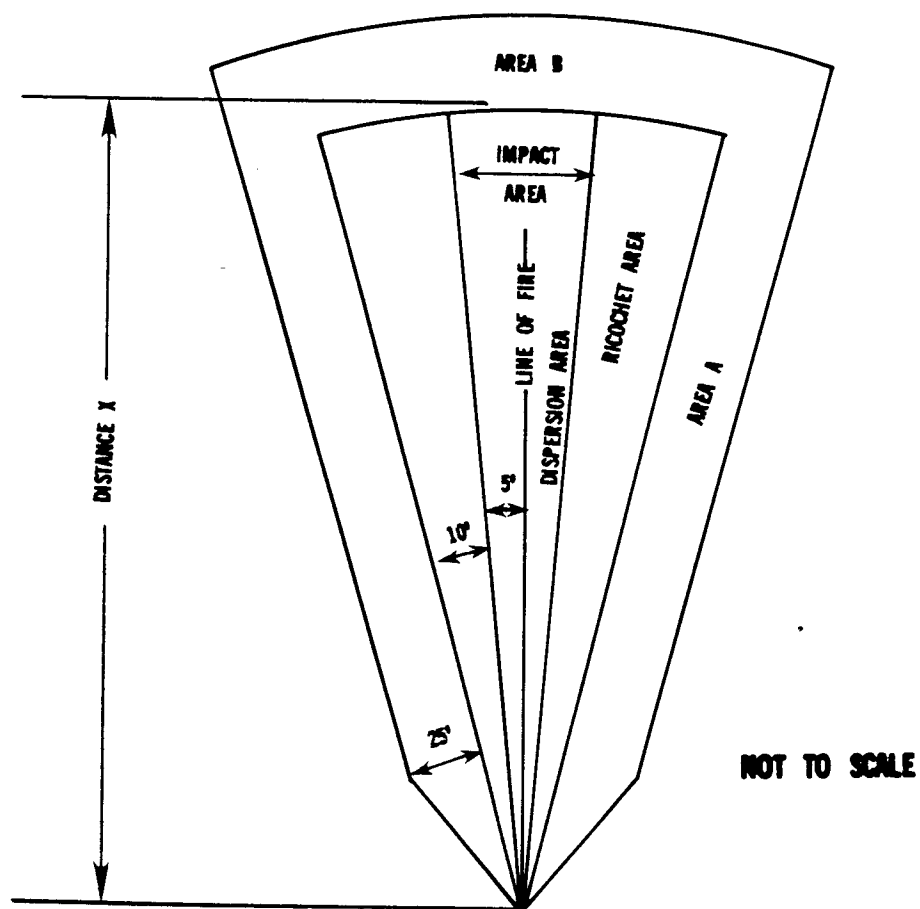


Figure 14-2. Surface danger zone for air defense weapons firing at ground targets in a ground support role

Chapter 15 Flamethrowers

15-1. Firing restrictions

a. Before using flamethrowers, all possible precautions will be taken to prevent personnel injury and property damage. The OIC is responsible for enforcing the rules in TM 3-1040-204-14 and TM 3-1040-209-12. The OIC will also—

(1) Assign an experienced coach to each trainee for initial training and indoctrination firing.

(2) Familiarize personnel with the operation of the equipment they are to handle.

(3) Clear the practice range of vegetation and other combustible or flammable material.

(4) Prohibit the firing of unthickened fuel into a head wind of more than 5 miles per hour. Also prohibit the firing of flamethrowers against sharp rising terrain or obstacles (such as trees or buildings) nearer than 15 meters from spectators and 6 meters from firer.

(5) Have qualified medical personnel and an emergency vehicle containing proper first aid equipment for burns at the firing site. Cease firing when an accident occurs, or until the emergency vehicle leaves the vicinity.

(6) Provide adequate firefighting equipment to prevent loss or damage to property and injury to personnel caused by fires ignited by the flame. During

initial training, two 10-pound, CO² fire extinguishers will be manned and positioned 10 meters to the rear or flank of the flamethrowers during firing.

(7) Comply with all applicable provisions of AR 700-68 on the use of fuel and pressure.

(8) Allow only the instructor, coach, or assistant operator to enter the surface danger zone during firing.

(9) Prohibit the use of oxygen or other flammable gases to charge pressure tanks or containers of flamethrowers.

(10) Prohibit the firing of mechanized and portable flamethrowers that are leaking fuel. When fuel is expended, remaining pressure in the fuel tanks of the flamethrower will be depressurized *without ignition*. This will be done by blowing down the remaining pressure on the flamethrower range away from any fire or fuel burning on the ground.

b. The maximum weapon depression during firing will not be more than 20 degrees below horizontal.

c. "No Smoking" signs will be prominently posted in the areas where fuel is being mixed and flamethrowers are being serviced or charged.

15-2. Surface danger zone

a. Zones for portable flamethrowers are 100 meters long with Areas A and B 50 meters each (fig 15-1).

b. Zones for mechanized flamethrowers are 275 meters long with Area A 50 meters and Area B 100 meters (fig 15-1).

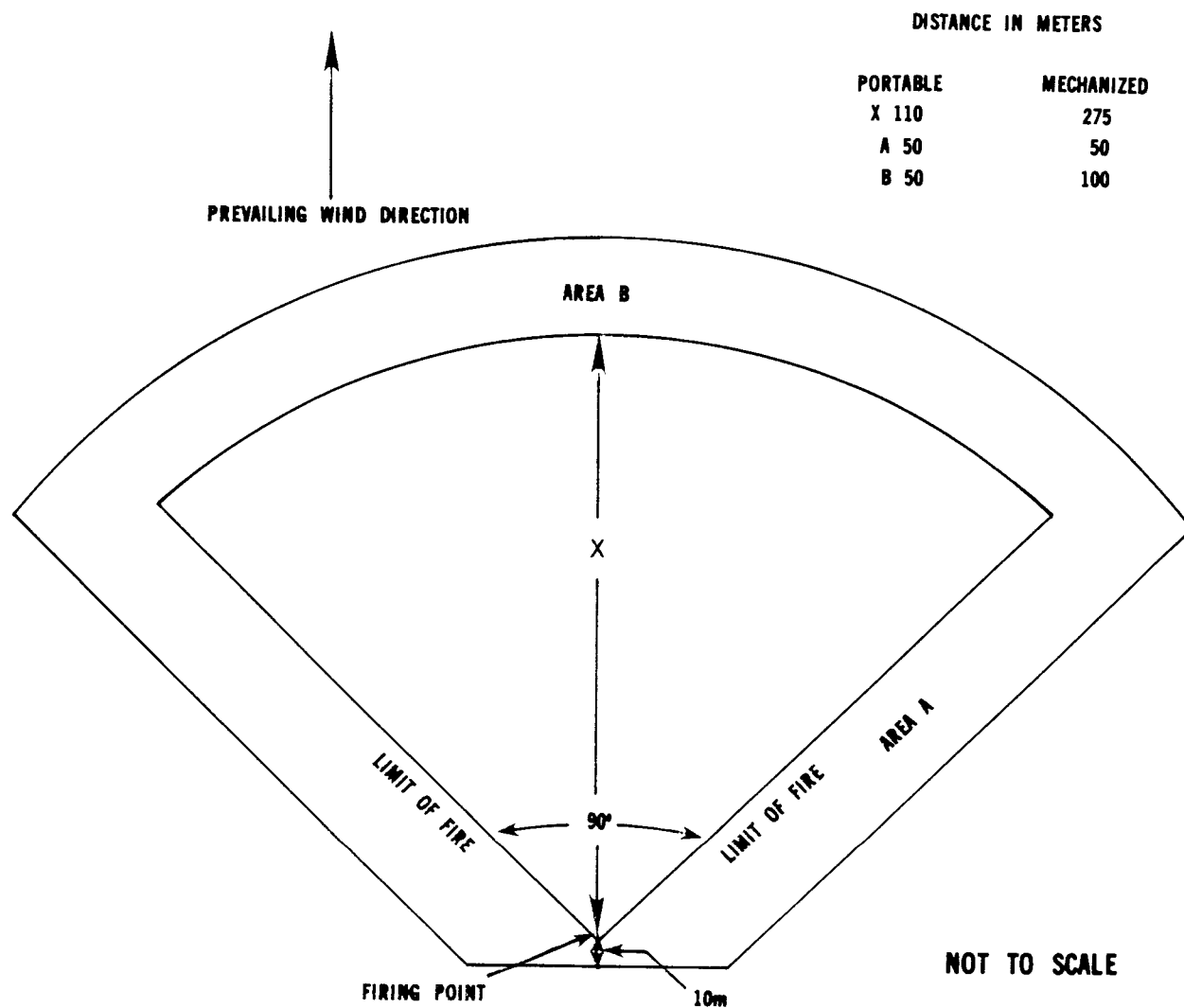


Figure 15-1. Surface danger zone for firing portable or mechanized flamethrower

Chapter 16

Live Fire Exercises

16-1. Safety during live fire exercises

a. This chapter prescribes policies and procedures to be used during live fire exercises. Live fire phases of training exercises must be conducted with maximum realism and safety. Every effort will be made to insure safety limitations and range configuration do not require soldiers to use combat firing techniques that would not be used in actual combat. If safety or terrain limitations do require some unrealistic actions to be taken, the soldiers should be briefed, in detail, on why certain "artificial" actions are required and what the unit would do if confronted with a similar situation in combat.

b. When maneuver forces use live fire from organic or external sources, they are taking part in a live fire exercise. CALFEX is two or more combat arms taking part in a live fire exercise, or when close air support is provided to a maneuvering force. This chapter permits troops on foot and in combat vehicles to maneuver through temporary impact areas when the provisions of paragraph 2-5d have been met. Air and ground weapons can be used in accordance with current doctrine in combined arms exercises unless specifically prohibited from use by this regulation or by other separate directives.

c. CALFEX provides an opportunity for commanders to plan, execute, and control tactical maneuvers in a realistic environment that incorporates organic and supporting fire. Prevention of accidents and injuries will be a primary concern in all live fire exercises due to the inherent complexity of fire and maneuver exercises and the need for coordination among participating and supporting units.

d. Close coordination between the joint participants in a live fire exercise will be done through the development of realistic fire, maneuver, and safety plans.

16-2. Information for commanders

a. Training to permit highly realistic maneuvers and live fire exercises involves specific personnel safety requirements. Installation commanders will publish range regulations (SOPs) that apply only to their installations. SOPs will define safety requirements to support live fire training exercises. Directives developed for a particular location are not authorized for use at a different location.

b. Commanders whose units participate in live fire exercises are responsible for the safety of their troops. Specifically, they will—

- (1) Comply with this regulation.
- (2) Comply with local range regulations and policies.
- (3) Train subordinate commanders, unit leaders and safety, and controller personnel to familiarize them with this regulation, training, installation range regulations, and safety procedures before conducting live fire exercises.
- (4) Develop a coordinated and detailed plan with range control.
- (5) Appoint a field grade officer to act as OIC of a battalion or larger size combined arms live fire exercise.
- (6) Provide for safety checks of each weapon system before firing live ammunition.
- (7) Make certain that all individual gunners who will take part in live fire exercises have fired and passed a qualification course for the crew-served weapon assigned to them. All personnel who will fire a weapon in the exercise will have fired, as a minimum, a familiarization course with that weapon.
- (8) Orient participants on the capabilities of the weapons used by other components in the CALFEX.

16-3. Exercise planning

a. Army Training and Evaluation Programs (ART-EPs), how to fight manuals, appropriate field manuals, and this regulation will be used in exercise planning. Live fire exercises must be conducted in accordance with accepted doctrine and safety requirements.

b. Detailed written plans will be developed between range control and the unit OIC and will include—

- (1) A detailed plan of maneuver and fire support.
- (2) A list of weapons, ammunition, pyrotechnic or smokes, and chemicals to be used.
- (3) Unit control measures, including means of communication.
- (4) Terrain features and facilities required.

c. Impact distance and limits of advance are as follows:

- (1) The distance to which unprotected troops can safely move near the impact area (i.e., Areas A, B, and C) is indicated in the chapter on each weapon or weapons system.
- (2) To determine how close unprotected troops may maneuver to the target area, an impact area and a surface danger zone must be established for each target area used. Surface danger zones must be computed and issued to leaders and safety personnel before starting the exercise. When several types of weapons are being fired into one target area, the combined total surface danger zone will govern. These restrictions normally should not preclude unit commanders from selecting tactically sound supporting weapons positions for their scheme of

maneuver, provided the positions and directions of fire do not exceed the total range area available for the exercise. Leaders and safety personnel will be shown the physical limits of the surface danger zone by ground survey.

(3) The short limit of the impact area may be moved in the direction of the target area by definite prearrangement to permit forward movement of troops.

(4) Demolitions may be used during live fire exercises according to chapter 18.

(5) Selection of weapon positions will be the responsibility of unit leaders taking part in the exercise.

(6) Selection of terrain over which live fire exercises are to be conducted will mostly determine realism of the exercise. Terrain configuration should be used to enhance safety features when terrain is being selected for live fire exercises involving overhead, flanking fire, or both.

16-4. Firing precautions

a. Only the installation commander (or designated representative) can authorize overhead fire.

b. The only weapons authorized for overhead fire over unprotected troops are:

(1) All artillery cannon firing indirect fire. See chapter 11 for safety precautions.

(2) Machineguns (5.56mm, 7.62mm, .30 and .50 caliber) on ground tripods or vehicle mounts (ring mounts excluded) firing from a stationary position.

c. Only ammunition approved for overhead fire will be used. (See chap 3.)

d. Overhead fire with any weapon may be authorized over protected troops, provided the troops have positive protection from the munitions being fired. (Protected troops are discussed in chap 11 and FM 5-15.)

e. All firing of indirect fire weapons will be from positions in which the site to mask allows engagement of the targets nearest to the forward line of troops. Selection of firing positions, direction of fire, and fall of shot must prevent the projectiles from striking trees or other obstacles in the area from the weapon position to a point forward of unprotected troops. The forward point is defined as the bursting radius of the round, plus 12 probable errors.

f. All firing of direct fire weapons will be from positions that provide an unobstructed field of fire. Selection of firing positions and direction of fire must prevent projectiles from striking any obstructions or projections, natural or manmade (trees, brush, hills, buildings, telephone or electric power poles). These could cause or contribute to a deflected projectile or ricochet between direct fire weapon firing positions and the troops over which the fire is to be delivered.

g. Overhead fire with machineguns in live-fire exercises will be as follows:

(1) Bullets will not be permitted to impact between the firing position and the rear of the line of unprotected troops. All impacts should be a minimum of 30 meters beyond the forward line of unprotected troops.

(2) Positive stops must be used to prevent crossfire and depression of the muzzle during firing.

(3) A minimum clearance or safety limit must be established using the guidelines for overhead fire in FM 23-65 and FM 23-67.

(4) Rate of fire will not exceed 70 rounds per minute for the M60 machinegun and not more than 40 rounds per minute for the .50 caliber machinegun.

(5) Weapons will be test fired before delivery of overhead fire to verify effectiveness of the positive traverse and depression stops.

h. In addition to g above, the following precautions will apply to overhead fire with machineguns for a confidence infiltration course.

(1) Firing will be from approved platforms as described in FM 21-75.

(2) The mounts and weapons will be inspected by qualified field maintenance personnel before being declared safe to deliver overhead fire.

(3) A minimum clearance of 5 meters over the heads of troops or the highest obstruction within the field of fire will be maintained. Minimum clearance is the distance between the lowest shot in the dispersion pattern (as determined by the test firing) and the bodies of individuals in erect positions on the highest point of ground, log, or other obstacle over which troops must travel, or heights of barbed wire strands or posts on the course, whichever is higher.

i. When conducting overhead fire with machineguns in live fire exercises, selection of firing positions and direction of fire must prevent the projectiles from striking trees or any other obstacles located between the weapon and to the rear of the forward line of unprotected troops. Also, the projectiles cannot impact less than 30 meters beyond the forward line of unprotected troops.

j. The following weapons or ammunition will not be fired over the heads of unprotected troops.

(1) All hand-held, shoulder-fired (except sniper weapons), or flex-mounted weapons. (Flex-mounted weapons systems are those that permit firing through a part of an arc or a complete arc and do not have positive stops provided to limit elevation, depression, and traverse of weapon during firing.)

(2) All recoilless rifles.

(3) All rockets and guided missiles.

(4) All mortars.

(5) 20mm, 25mm, 30mm, and 40mm weapons systems.

(6) All weapons firing antipersonnel-type (beehive) cartridges.

(7) 90mm, 105mm, and 120mm tank guns.

(8) Simulators and M125 and M127 series ground illumination signals.

k. The firing of any weapon over unprotected troops from a moving vehicle or aircraft is prohibited.

l. All weapons may be used to provide flanking fire. However, the safety precautions for delivery of flanking fire for each weapon described in this regulation pertaining to the particular weapon or weapons system must be enforced.

(1) Cannon and mortar flanking fire must not impact any closer to unprotected troops than the fragmentation radius (Area A) prescribed for each weapon.

(2) Small arms (5.56mm, 7.62mm, .30 and .50 caliber) ground-mounted or vehicle-mounted machineguns may be fired at low angles of elevation (near the flank of an individual or unit). However, there must be an angle of 15 degrees (267 mils) or more between the limit of fire and the near flank of the closest individual or unit and all impacts are beyond the individual or unit. Traversing and depression stops will be provided on machineguns to maintain the required angle and distance between the line of fire and the near flank of an individual or unit.

(3) Positive means will be used to permit the firing unit to know the location of the maneuver units while fire support is being provided to make certain no unprotected personnel are within the sector of fire. The route and location of maneuver units and the location of those weapons providing supporting fire will be described in detail using recognizable natural terrain features, manmade terrain features, or other type features.

16-5. Fire control

The unit commander makes the final decisions on fire control measures. The following conditions must be met:

a. The ammunition in (1) through (4) below may be authorized for use in live fire exercises only when it is fired into designated (dedicated) impact areas through which troops are not permitted to maneuver:

- (1) 40mm high explosives (HE).
- (2) 66mm LAW (HE).
- (3) Hand grenades (HE).
- (4) Improved conventional munitions (ICM).

b. Safety requirements for the use of all weapons systems will be as stated in the applicable chapter of this regulation (e.g., use of artillery weapons will be according to chap 11).

c. Fire coordination control measures must be understood by maneuvering elements and those elements providing supporting fire.

d. Final coordination lines must be identified to both the maneuvering elements and to elements providing supporting fire. These lines will be identifiable on the ground as natural terrain features (such as a streamline), manmade features (such as a road), or other type features (such as engineering tape).

e. Weapons used in live fire exercises will be controlled so that Areas A, B, C, or E of the surface danger zone for each weapon do not overlap areas in which unprotected troops will maneuver.

f. When there are appreciable differences in the minimum safe distances for the several air and ground weapons to be employed in the live fire exercise, separate targets should be established for each type of weapon to permit target engagement at the minimum safe distance.

g. An RSO (NCO) will directly supervise and control the throwing of fragmentation grenades. The following procedures apply:

(1) Hand fragmentation grenades can be thrown during live fire exercises, but the fragmentation characteristics of the grenades must be considered and appropriate safety precautions taken:

(a) Designate an impact area free of obstacles (such as trees and tank hulls).

(b) Maintain a minimum side-to-side distance of 5 meters between each individual during the throwing exercise.

(c) Designate throwing positions that protect the throwers from fragments and provide cover for all other participants. This can be natural terrain or constructed barriers.

(d) Comply with the provisions of paragraph 7-1b and c during live fire exercises. Dud grenades will be destroyed in place by qualified EOD personnel (TM 9-1300-206) before troops enter the grenade impact area.

(2) Individuals being transported by vehicle or aircraft will not carry fragmentation or white phosphorus grenades attached to web equipment.

16-6. Maneuver in the temporary impact areas

a. Installation commander, after assessing the hazards, may authorize maneuver through temporary impact areas in accordance with paragraph 2-5d, except as noted in this chapter.

b. The following types of ammunition are extremely sensitive once they have been fired and have failed to explode (DUD state). Access must be controlled, as they pose a serious threat to life safety of maneuvering troops:

- (1) 20mm high explosives (HE).
- (2) 30mm HE.
- (3) TOW, high explosive antitank (HEAT).
- (4) DRAGON, HEAT.
- (5) All HEAT ammunition due to type of fuze action and sensitivity.

c. The clearance of areas into which these items have been fired is also difficult and hazardous to persons doing the clearing and must be closely monitored.

d. The types of ammunition described in b above do not preclude maneuvers but do increase the risk to ma-

maneuvering troops. The problems created by firing these types of ammunition into temporary impact areas through which troops maneuver should be carefully evaluated before the installation commander authorizes its use.

16-7. Air support

a. Fire support by aircraft. During live fire exercises, as a minimum, the following control procedures prior to firing aircraft-mounted weapons and/or dropping air-delivered bombs is required:

- (1) Positive identification of troop location is required.
- (2) Positive identification of target is required.
- (3) Approved abort procedures and locations to drop unexpended bombs when necessary are required.
- (4) Attack flight paths, location of bomb safety lines, and access corridors will be known and visually identified by ground personnel and participating aircrews.
- (5) Direct communications will be established and maintained between the OIC, the forward air controller, and the fire support coordination center that coordinates the direct support artillery fire in the vicinity of an airstrike.

(6) Minimize danger to attacking aircraft from ricochet of ground-fired projectiles by firing high explosive ammunition and ceasing fire by flat trajectory weapons in the vicinity of targets under attack.

(7) Clearly mark the location of friendly troops as they can be easily identified from the air.

(8) Firing across, within, or through access corridors will not be permitted without coordination with the forward air controller. Other ground fire may be continued. Extreme care must be taken on high trajectory (artillery and mortar) weapons bordering the corridor. These weapons will cease fire when the flight path of the aircraft is equal to or lower than the sum of the maximum ordinate and the bursting radius of the round (Area A).

b. Fire support by rotary wing aircraft. See chapter 13.

c. Fire support by fixed wing and high performance aircraft. See AFR 60-18, and TAC Regulation 55-18 (HQ TAC/DAP, Langley AFB, VA 23665) for stand-off distances (surface danger zone requirements) required to protect unprotected personnel. Marine Corps fire support by aircraft will be governed by range regulations promulgated by the local commander.

Chapter 17

Chemical Agents, Smokes, and Aircraft Spray

17-1. General restrictions.

The use of chemical agents authorized for training purposes is subject to the following restrictions.

a. The use of lethal or incapacitating chemical agents in training is prohibited, except when authorized or directed, in writing, by the Department of the Army (DAPE-HRS) or the Commandant of the Marine Corps (Code T). The use of chemical agents must be addressed in a special safety analysis on a case-by-case basis.

b. Portions of this regulation which cover the firing of HE ammunition apply to chemical-filled ammunition when the ammunition is assembled with explosive-loaded components. The same protective covering and boundary limits used during training with high explosive ammunition are required to protect against fragments and ricochet of chemical ammunition.

c. Riot control agents will be used on the advice of a school-trained nuclear, biological, chemical (NBC) officer, or an NCO who is thoroughly familiar with field behavior, individual protective equipment, and first-aid requirements for these agents. This applies to either bulk agents or agent-filled ammunition. When riot control agents are used in training exercises, the following additional policies apply:

(1) Riot control agents will not be used under conditions that are dangerous to life or property outside the training area. In addition, these agents will be used far enough from public or heavily traveled installation roads and inhabited areas so that a change of wind direction will not carry the materials into these areas.

(2) When training personnel in methods of contamination, traversing contaminated areas, and use of protective clothing and equipment, tests will be conducted after riot control agents have been used. All contaminated areas must be satisfactorily decontaminated or marked.

(3) Riot control agents in the open are nontoxic. School-trained NBC personnel will supervise their use to insure that only personnel involved in the training are affected. Training with riot control agents will be restricted to authorized training exercises and chambers. Release of riot control agents by aircraft will be closely monitored by trained chemical personnel to preclude accidental contamination of populated areas.

d. A school-trained NBC officer or an NCO will supervise mask confidence training. (See FM 21-48).

17-2. Firing precautions

Firing of projectiles or dropping bombs containing

chemical agents or materials that may be harmful to the environment or wildlife into or over land and water is prohibited. The commanding general of the major command involved or the Commandant of the Marine Corps (Code T) may obtain exceptions from responsible conservation authorities.

17-3. CS (0-chlorobenzalmalononitrile) riot control agents

CS and CS-1 will be used in training only under the supervision of an NBC officer or an NCO who has received formal training in the characteristics, capabilities, and training applications of these agents. Only CS in capsule form may be used in the CS chamber.

a. Avoid releasing the agent when personnel located downwind will be affected unless exposure to a controlled concentration is desired. The agent will not be released within 50 meters of spectators located upwind.

b. CS agents affect the eyes, the respiratory tract, and moist skin areas of the body. A field protective mask and field clothing with collar and cuffs buttoned and trouser legs tucked into boots will protect against field concentrations of the agents. Personnel handling or dispensing bulk CS will wear rubber gloves, hood, rubber boots, rubber apron, protective masks, and field clothing secured at neck, wrists, and ankles. Those affected by CS should move to fresh air and face into the wind for 5 to 10 minutes, avoid rubbing eyes, and keep well spaced from other affected personnel. If gross accidental contamination with CS agent occurs, promptly flush the body with lots of cool water. A 5-percent sodium bisulphite solution should be used to remove the remainder of the agent (except in and around the eyes), and then rinse the body with water. If sodium bisulphite is not available, a 1-percent solution of sodium carbonate, sodium bicarbonate, or yellow GI soap and water may be used. When showering after any exposure to a CS agent, first flush the body with cool water for 3 to 5 minutes before proceeding with normal showering. If agent residue is on the clothing, remove the clothing to prevent unmasked personnel from being affected. See FM 21-48 for additional information on the use of CS in training.

c. When riot control agents are transported in Army or Marine Corps aircraft, compliance with paragraph 3-15, AR 95-1 or MCO P4030.19 is required.

17-4. Smoke

a. When FS smoke (sulfur trioxide-chlorosulphonic acid solution) is released from an airplane, a considerable portion of the material will eventually fall to the ground in the form of small drops of undecomposed FS and of hydrochloric acid. Similar corrosive agents are

present in the smoke produced by FM (titanium tetrachloride).

b. The following restrictions will be observed in the laying of FS or FM smoke from airplanes.

(1) Smoke-producing material will not be released at altitudes greater than 100 meters above ground.

(2) Be cautious in the release of smoke-producing material in training exercises to minimize the possibility of damage to personnel and property that might result in claims against the Government. Smoke-producing material will not be released near or within a horizontal distance of 1,200 meters from personnel, livestock, buildings, or other structures, equipment, conveyances, cultivated areas, or other objects. (Exception: personnel involved in or Government equipment used in a tactical exercise when suitably protected. See FM 21-48.)

(3) Smoke-producing material will not be released when the wind velocity is greater than 15 knots.

c. Be cautious in the release of FS or FM from artillery or mortar shell, land mines, and chemical cylinders in training exercises to minimize the possibility of damage to personnel or property that might result in claims against the Government. Release of FS or FM in quantities greater than 6 ounces will not be permitted within a horizontal distance of less than 300 meters from personnel, livestock, buildings, or other structures, equipment, conveyances, cultivated areas, or other objects. (Exception: personnel involved in or Government equipment used in a tactical exercise when suitably protected.)

d. Government equipment contaminated with the corrosive acids produced by liquid smoke will be washed with water immediately after the exercise, except when other methods of protection and/or cleaning are prescribed in technical manuals.

e. To prevent burns when HC (hexachloroethane) smokepots are fired manually, the firer must keep his or her face averted and, after igniting it, should move quickly to a distance of 30 meters. Since HC smokepots produce great heat when burning, precautions must be taken to prevent fires. HC smokepots will never be fired

inside buildings, tents, or other inclosed areas because of fire and health hazard from the fumes. Since the addition of water to HC smoke mix may cause it to burn erratically, explode, or produce spontaneous combustion, HC smokepots must be kept dry before use. Prolonged exposure to HC smoke may cause lung and eye irritation. Personnel remaining in even, low concentrations of HC smoke for more than 5 minutes will wear field protective masks.

f. The candle, smoke, oil, SGF2, M6 is used to produce a nontoxic oil smoke in confined areas primarily to simulate fires in buildings or ships for fire drills and to train firefighters. When used in a building or ship, do not throw the smoke candle. Place it on its base on a stable platform, pull the safety pin and release the safety lever. Since this candle burns smokeless powder within its body to vaporize the fog oil, do not fire on or near combustible items.

g. Restrictions on the use of the M8 HC smoke grenade are basically the same as those for the HC smokepot. The M8 grenade will start fires in combustible materials and will cause burns to personnel. They should remain at least 10 meters from burning grenades. See paragraph 7-2 for precautions in using chemical hand grenades.

17-5. Aircraft spray

When chloroacetophenone solutions (app E, FM 21-48) are sprayed from aircraft at low levels, permanent injury to unprotected eyes and severe irritation of the skin of personnel may occur. To prevent such injuries, the following precautions will be taken:

a. Troops will be cautioned that, unless the eyes are protected, it is dangerous to look up when an airplane spraying CN solution is immediately overhead, has passed over, or just upwind of them.

b. Troops contaminated with the liquid in a spray attack will remove their clothing as soon as possible and take a shower or bath, using plenty of soap and water. The eyes, if contaminated, should be flushed promptly with fresh water. See FM 21-48 for further information.

Chapter 18

Mines, Firing Devices, Trip Flares, Simulators, and Explosive Charges

18-1. General

This chapter prescribes the general procedures for handling and detonating explosives, mines, firing devices, trip flares, and simulators used by troops in training. It does not include projectiles, rockets, bombs, fuzes, or firing devices covered in other paragraphs of this regulation, unless otherwise stated.

18-2. Firing precautions

The following safe practices pertain to standard military and commercial explosives used by the Army. They also pertain to items containing explosives such as demolition blocks, mines, shaped charges, the bangalore torpedo, mine-clearing demolition snakes, and the blast-driven earth rod.

a. General safe practices for handling and transporting explosives are prescribed in TM 9-1300-206, TM 9-1375-200, and FM 5-25.

b. Demolition projects using EOD personnel will be in accordance with AR 75-15.

c. Commercial dynamite will not be stored for prolonged periods at temperatures above 90 degrees Fahrenheit because exudation of the nitroglycerin is likely to occur. Also, it will not be stored below 32 degrees Fahrenheit because freezing tends to make it sensitive to shock. Containers of dynamite will not be moved or transported if there is evidence of exudation or if it has been frozen. In such cases, EOD personnel should remove and dispose of the unserviceable dynamite.

d. The gases released by the detonation of common explosives are toxic. Breathing these fumes should be avoided by positioning personnel upwind from the detonation point.

18-3. Temporary storage in training areas

When temporary open storage is used, no pile or stack should exceed 500 pounds of explosives. Distance between the piles or stacks should not be less than 45 meters. Demolition materials, dynamite, black powder, and detonators will each be placed in a separate shelter or pile in the field. They will be separated by appropriate intraline separation distances based on the governing hazard class of the items in each stack as provided in AR 385-64. Practice demolitions and inert service components will each be placed in a separate pile or stack designated for that type of materiel.

18-4. Firing

a. Lightning and other sources of extraneous elec-

tricity can initiate electro-explosive devices used in demolition training operations. Although the nonelectric blasting technique is invulnerable to most extraneous electric signals, it is not invulnerable to lightning. For this reason, *all demolition training operations must be discontinued during or on the approach of an electric storm or severe dust storm.*

b. Electrical firing will be used with caution or will be replaced by nonelectric firing systems when the possibility exists of unintentional detonation from extraneous electric energy. There are ways that electric blasting circuits may be checked for stray electromagnetic energy such as with a blaster's volt-ohmmeter, or a No. 47 radio pilot lamp; however, these methods will not detect nontransmitting portable equipment that may be in the vicinity. For this reason, total reliance must not be placed on these methods to insure safety of personnel. Areas selected for demolition training sites will be surveyed for electromagnetic energy. They will be controlled to prevent entry of portable transmitting equipment in the surrounding area. The data in tables 18-1, 18-2, and 18-3 showing transmitter and radiative power in watts and minimum separation distances to electric blasting operations apply to operating radio, radar, and television transmitting equipment.

(1) Electric firing will not be used for demolition training when surveys show that the transmitted field strength exceeds energy levels shown in tables 18-1 through 18-3.

(2) For radar transmission near demolition operations, the data in table 18-1 apply to side beam illumination only. Stops should be provided on the radar equipment to insure that the explosives area will not be illuminated by the main beam.

c. Electric firing will not be performed in training within 155 meters of energized power transmission lines. When it is necessary to conduct blasting operations at distances closer than 155 meters to power transmission lines, nonelectric firing systems will be used or the power transmission lines will be deenergized.

d. Static electricity also creates a hazard when explosive training operations are being conducted. Possible sources of static electricity will be eliminated from the area where electric firing is planned; otherwise, nonelectric firing systems will be used.

18-5. Preparation of pits and setting charges

When explosive charges (TNT blocks or composition C4) are used to simulate detonation of mines and incoming artillery projectiles, mortars, and bombs, the following requirements will be observed:

a. *Preparation of pits.*

(1) Fire charges in specially prepared detonation pits with the charge positioned in the center of the pit.

(2) Use charges of only standard issue TNT blocks or composition C4 that do not exceed one-quarter of a pound. Do not cut or break TNT blocks in excess of one-quarter pound to obtain one-quarter-pound charges.

(3) Provide a suitable barrier to prevent personnel from approaching closer than 3 meters from the center of specially prepared detonation pits.

(4) Detonate charges electrically from a position that allows a clear view of the pit and the immediate vicinity. Follow safety precautions in paragraph 18-4 and tables 18-1 through 18-3 when using electric blasting caps and circuits.

(5) Place blasting circuit wires leading to charges in the detonation pits in buried conduit or otherwise secure to prevent personnel from crawling through the area entangling their equipment in the wires.

(6) Enclose detonation pits by a ring of sandbags at least 0.6 meters above the surrounding ground. Make the inside diameter of the ring at least 2 meters. Provide wire entanglement or other type barrier that does not project above or outside the top of the sandbag ring at a radius of 3 meters from the point of detonation. This will prevent ear damage from overpressure and personnel from crawling or rolling into the pit.

(7) Evacuate the detonation pit in the shape of a cone, at least 1.5 meters in diameter by 0.6 meters deep. Back-fill the excavated area with sand that has been screened and is pebble and stone free. Also use pebble and stone-free sand in the sandbags forming the ring around the perimeter of the pit. Make certain at least 0.3 meters of sand are placed beneath the charge at the time of firing. The course and the detonation pits will be free draining. Detonation pits larger than the minimum size are preferred to provide a greater depth of sand that will permit better pit drainage and reduced maintenance.

(8) Place and fire only one charge in a pit at one time.

(9) When sand is placed over the charge to simulate debris from explosion of a projectile on impact, do not detonate the charge unless the personnel are past the pit, or are at least 8 meters from the pit if approaching.

(10) For training and tactical exercises, use sand-bagged pits back-filled with sand (7 above) in training courses and in maneuvers. This will allow for close approach (less than 140 meters) of personnel before detonating the charge. Since personnel may be erect, charges

will not be detonated within 25 meters. Bury all wires leading to charges or place them to prevent tripping or damage to the blasting circuit. Use TNT blocks for site preparation, if available; if not available, use composition C4.

(11) Use loose-sifted sand in the bottoms of detonation pits. Also inspect barricades surrounding pits. They must not contain loose fragments that might be blown onto the course by the charges. Despite these precautions, it is possible that sizable hard objects may remain undetected in the earth in the sides or the bottom of the pits and may be blown onto the course by a later explosion.

b. Placement of charges.

(1) Fire, electrically, all prepared demolition charges in training with the exception of primers made for instruction in the use of nonelectric caps and time fuzes. Fire these charges or nonelectric caps and time fuzes untamped above the ground surface. This practice assists in investigation of misfires.

(2) Prime underground charges when possible with detonating cord attached to the blasting cap above ground.

(3) Place charges against steel, concrete, wood, or other solid materials on the side nearest the observers so that major fragments are propelled away from them. Provide personnel protection against debris and overpressure in the area forward of the charge.

(4) Assure that not more than five trainees will actually insert blasting cap or primer in charges. This will be supervised by one instructor after the remainder of the trainees and observers have withdrawn to a safe position.

18-6. Missile hazard

a. Explosives can propel lethal missiles to great distances. How far an explosion-propelled missile will travel in air depends mainly on the relationship between weight, shape, density, initial angle of projection, and initial velocity. The missile hazard from steelcutting charges extends a greater distance under normal conditions than that from cratering, quarrying, or surface charges of bare explosives.

b. The following criteria give the missile hazard distances at which personnel in the open are relatively safe from missiles created by bare charges placed in or on the ground, regardless of type or condition of the soil:

Charges	Missile hazard distance
Over 500 pounds	Minimum, 800 meters.
27 to 500 pounds	Computed from the formula: Missile hazard distance in meters equals 100 times the cube root of the pounds of explosives ($D = 100 \times W^{1/3}$)

Charges**Missile hazard distance**

Less than 27 pounds Minimum, 300 meters. When charges are placed on specially prepared or selected sites (para 18-11b) to eliminate a missile hazard, the minimum distance may be reduced to not less than 50 meters.

c. For personnel, provide missile-proof shelters designed to prevent fragment and debris penetration when charges are placed to demolish solid material. These shelters will be placed at least 100 meters from the detonation site and will be strong enough to withstand the heaviest material that might be thrown at them.

18-7. Blast effect

a. Generally, the greatest danger to personnel are missiles thrown by the explosion. Blast effect (i.e., increase in air pressure) is a hazard where special protective features are used at detonation or demolition sites

to eliminate or confine missiles and provide for detonation of charges close to personnel. In blasting, both overpressure and noise level can, under certain conditions, be hazardous.

b. The overpressure caused by the explosion must not exceed 2 pounds per square inch at locations occupied by personnel unless special hearing protection devices (earplugs or muff-type devices) are worn.

c. When properly designed protective barriers are not provided to dampen and reduce overpressure, the minimum distance between observers and detonation site to reduce overpressure to acceptable levels is as follows:

Pounds of explosives $\frac{1}{4}$ $\frac{1}{2}$

1

2

3

4

Distance in meters

6

7

10

12

14

16

These distances should be increased when feasible to reduce noise level.

d. The distance between personnel in a prone position and charges of not over one-quarter of a pound in a specially prepared detonation pit ringed by sandbags to a height of 0.6 meters above ground may be reduced to 3 meters.

18-8. Charges placed on steel and concrete

a. Charges placed on steel will not exceed 2 pounds. They will be fired within an appropriate confining structure with an excavated pit at least 1 meter deep. If fired in an open pit, a mat made of hemp-type material should cover the charge. Personnel should be at least 300 meters away in defilade and preferably under cover or at least 100 meters away in a missile-proof shelter.

b. Charges placed on concrete should not exceed 40 pounds and should be placed on the side nearest the observers. Observers should be at least 100 meters away in a missile-proof shelter, or 300 meters away and in defilade from the charge when missile-proof shelters are not available. An unoccupied distance of 900 meters must be provided on the opposite side of the charge since this is where most of the missiles will be thrown.

18-9. Firing of shaped charges, bangalore torpedoes, mine-clearing snakes, and blast-driven earth rod

a. Shaped charges will be oriented to direct the gas jet toward the target. They should be placed on the side of the target nearest the observers when practicable. Observers will be at least 275 meters from the shaped charge when fired and in defilade from the charge, or in a missile-proof shelter at least 100 meters from the charge.

b. Bangalore torpedoes will be fired only in a horizontal position on the ground. Personnel will be in a missile-proof shelter 100 meters from the charge, or 200 meters away in defilade, or 500 meters if no shelter is provided.

c. When firing the M2A1, M3, or M157 demolition snakes, those not protected from fragments will not be allowed in front of the snake or in the area 400 meters to the rear and 900 meters on each side. Those in foxholes or with equivalent protection from missiles may be allowed in the area at least 230 meters away from the snake in all directions except in front.

d. When firing the M1 antipersonnel-mine-clearing snake or the M1 antipersonnel-mine-clearing detonating cable, no personnel should be forward of the initial

location of the tail. Those firing the snake should take cover in a prone position at least 80 meters behind the tail.

e. When firing the blast-driven earth rod, unprotected personnel will be at least 100 meters from the rod, or in a missile-proof shelter 50 meters from the rod because of a possible rupture of the demolition confinement structure. No explosives other than the standard issue-propelling charge will be used in the structure. The structure should be examined carefully before each firing for any evidence of cracking, bulging, or other faults.

f. When firing the shaped charge, bangalore torpedoes, and mine-clearing snakes, in addition to observing safe distances (*a* through *e* above), all personnel will wear steel helmets and ear protection.

18-10. Cratering

a. The maximum charge to be fired in training will not exceed 320 pounds.

b. Personnel not in missile-proof shelters will be at a distance from the charge as cited in paragraph 18-6. All

personnel will wear steel helmets and ear protection. They may occupy a missile-proof shelter located not less than 100 meters from the detonation site, if it is strong enough to withstand any material propelled onto it by the detonation.

c. All cratering charges will be dual primed with detonating cord. Blasting caps will not be placed underground. Electric and nonelectric caps will be attached to the detonating cord above ground.

18-11. Training in priming demolition blocks and other bare charges

a. The distance required by paragraph 18-6 may be reduced for the surface firing of bare charges by providing a specially prepared detonation site. For charges of not over 5 pounds, the distance between charge and personnel may be reduced to not less than 50 meters when the site conditions equal those given in *b* and *c* below.

b. Charges will be detonated on sand that has been screened and is pebble and stone free. The sand cushion will be not less than the following minimum dimensions:

Pounds of explosive	Radius of sand surface (in meters)	Depth of sand (in meters)
¼	0.6	0.2
½	1.0	0.3
1	1.3	0.5
2	1.6	0.6
4	2.0	1.0
5	2.3	1.1

Subsequent charges will not be placed where depth of sand has been reduced by cratering of previous detonation.

c. Charges are detonated on soil free from gravel, rock, metal, or other possible missiles to a depth of at least 6 inches. Preparation will include loosening and raking the soil. A sandbag barricade of at least 1 meter above surrounding level ground will be provided between location of charge and personnel. Charge will be placed not less than 1 or more than 2 meters from the barricade. The detonation site will be maintained to prevent formation of clods or exposure of gravel or rock on or near the surface.

18-12. Mines, fuzes, firing devices, trip flares, and simulators

a. Precautions. The following general precautions apply to high explosive or service, practice and inert mines, related fuzes, firing devices, trip flares, and simulators. Practice and inert mines will be color coded in accordance with MIL STD-709A and TM 9-1300-200, paragraph 1-6. They will have the proper identification marking stenciled on them. Service, practice, and inert mines and fuzes will not be mixed.

b. Antitank and antipersonnel mines.

(1) *Inert mines.* Inert mines and mine fuzes do not contain any explosives; therefore, they do not present a safety hazard. They will be color coded and marked in accordance with MIL STD-709A to prevent being mixed with practice and high explosive mines (AR 385-65).

(2) *Practice mines.* Practice mines and their fuzes contain a small, low explosive charge or a smoke-producing increment. They will be color coded in accordance with in MIL STD-709A.

(3) *High explosive mines.* These mines normally are not used in training except for demonstration purpose. On such occasions, they will be detonated by electrically primed one-half pound charge placed on the pressure plate. Personnel will wear steel helmets and ear protection. They will be behind suitable barricades, terrain features, or in trenches at least 200 meters from the mine at the time of detonation. No metal, rocks, or pebbles will be in contact with the mine or in the area immediately adjacent to it.

c. Firing devices.

(1) Firing devices will be used extensively in training to activate mines and install boobytraps.

(2) Instructions in TM 9-1375-213-12 will be followed when installing, arming, and disarming firing devices.

(3) The following general precautions will be observed during use:

(a) Firing devices and fuzes either with or without the standard bases will not be pointed at personnel.

(b) Standard bases containing unfired percussion caps, firing devices, and fuzes will not be carried in the pocket.

(c) Standard bases containing unfired percussion caps will be kept separated from firing devices and fuzes until the firing device or fuze is ready to be installed in the mine or boobytrap.

(d) Safety pins on firing devices and fuzes should be checked for ease of movement before attaching the standard base. The safety pins for locking and positive safeties should move easily.

(e) Camouflage of mines or boobytraps will be completed before removing the positive safety from the fuze or firing device.

(f) Armed firing devices or fuzes having a tripwire attached will have a positive safety installed before removing it.

d. Antipersonnel mine fuze M605. The assembly, arming, and disarming of this fuze will be in accordance with TM 9-1345-203-12.

e. Trip flares, M48, and M49.

(1) Instruction in the use, emplacement, and fuzing of these flares to students will be by using inert flares.

(2) Each service trip flare used in training will be fenced or guarded to prevent personnel from approaching within 2 meters of the emplaced flare.

(3) Trip flare firing positions will be cleared of flammable material to prevent accidental fires. The M48 trip flare should not be used in areas where a fire could cause serious damage.

f. Simulators.

(1) *Explosive M80 (formerly firecracker M80).* The explosive in this item will cause very serious injury. It will detonate 3 to 5 seconds after ignition of the fuse cord. The fuse cord tip should not be split since this reduces the fuse burning time and increases potential injury to personnel. WARNINGS:

(a) Do not use M1- and M2-type fuse igniters to ignite the M80 fuse cord.

(b) Do not hold the M80 simulator when ignited.

(2) *Other simulators.* The procedures for safe use of these items are in TM 9-1370-200. All personnel firing simulators will know all the safety requirements in this TM and will follow those instructions at all times. No attempt will be made to disarm or disassemble simulators under any conditions.

(3) Atomic Explosion Simulator, M142 firing precautions. See TM 9-1370-207-10.

g. Commercial fireworks. Commercially manufactured fireworks (those for civilian use) will not be handled, stored, or used in any way by military personnel on an installation.

Table 18-1. Minimum safe distances between RF transmitters and electric blasting operations

Transmitter power (watts)		
	Commercial AM broadcast transmitters	HF transmitter other than AM broadcast
100	750	750
500	750	1700
1,000	750	2400
4,000	750	4800
5,000	850	5500
10,000	1300	7600
25,000 ¹	2000	12000
50,000 ¹	2800	17000
100,000 ²	3900	24000
500,000 ²	8800	55000

¹ Present maximum power of US broadcast transmitters in Commercial AM Broadcast Frequency Range (0,535 to 1,605 MHz).

² Present maximum for International Broadcast.

Table 18-2. Minimum safe distances between mobile RF transmitters and electric blasting operations

Transmitter power watts	Minimum Safe Distances (Feet)				
	MF 1.6 to 3.4 MHz Industrial	HF 28 to 29.7 MHz Amateur	VHF 35 to 36 MHz Pub. use 42 to 44 MHz Pub. use 50 to 54 MHz Amateur	VHF 144 to 148 MHz Amateur 150.8 to 161.6 MHz Public use	UHF 450 to 460 MHz Public use
5 ¹					
10	40	100	40	15	10
50	90	220	90	35	20
100	125	310	130	50	30
180 ²					
250	200	490	205	75	45
500 ³			290		
600 ⁴	300	760	315	115	70
1,000 ⁵	400	980	410	150	90
10,000 ⁶	1,250		1,300		

1 Citizens band radio (Walkie-Talkie)(26.96 to 27.23 MHz)-minimum safe distance is 5 feet.

2 Maximum power for 2-way mobile units in VHF (150.8 to 161.6 MHz range) and for 2-way mobile and fixed-station units in UHF (450 to 460 MHz range.)

3 Maximum power for major VHF 2-way mobile and fixed-station units in 35 to 44 MHz range.

4 Maximum power for 2-way fixed-station units in VHF (150.8 to 161.1 MHz range.)

5 Maximum power for amateur radio mobile units.

6 Maximum power for some base stations in 42 to 44 MHz band and 1.8 MHz band.

Table 18-3. Minimum safe distances between TV and FM broadcasting transmitters and electric blasting operations

Effective radiative power (watts)			
	Channels 2 to 6 and FM	Channels 7 to 13	UHF
up to 1,000	1,000	750	600
10,000 ¹	1,800	1,300	600
100,000 ²	3,200	2,300	1,100
316,000 ²	4,300	3,000	1,450
1,000,000 ³	5,800	4,000	2,000
5,000,000 ³	9,000	6,200	3,000
10,000,000	10,200	7,400	3,500
100,000,000			6,000

1 Present maximum power, Channels 2 to 6 and FM.

2 Present maximum power, Channels 7 to 13.

3 Present maximum power, Channels 14 to 83.

Chapter 19 Lasers

19-1. General

This chapter prescribes safety procedures to be followed in the use of laser devices listed in tables 19-1 and 19-2.

19-2. Hazards

a. Devices listed in table 19-1 can seriously injure the unprotected eyes of individuals within the laser beam. Intrabeam viewing of either the direct beam or the beam reflected from a flat mirror-like surface exposes the unprotected eye to a potential hazard and must be avoided. (See figs 19-1 and 19-2.)

b. A potential eye hazard also exists when viewing a diffuse surface (used as a lasing target) from any angle within distance t uprange from the laser (table 19-1) because of the possibility of the reflected beam's being hazardous and should be avoided.

c. A less severe hazard exists for devices listed in table 19-2, but intrabeam viewing of the laser beam at distances less than that specified with the unprotected eye should be avoided.

d. The hazard of exposure to the skin is small compared to the eye; however, personnel should avoid direct exposure to the skin within distance t (table 19-1).

19-3. Laser devices

The items below are laser devices:

a. *AN/GVS-5 Laser Range Finder Infrared Observation Set (Hand-held).*

b. *AN/PAQ-1 (LTD) Laser Target Designator.* This is a lightweight, hand-held, battery-operated laser device. Forward observers use it to designate point and area targets for aircraft and point target designators for missiles and projectiles equipped with laser-energy seekers.

c. *AN/PAQ-3 (MULE) Modular Universal Laser Equipment.* This is a Marine Corps laser designator used with laser-energy homing munitions. The MULE is man portable and is used only in a dismounted mode.

d. *AN/TVQ-2 (G/VLLD) Ground/Vehicle Laser Locator Designator.* This is the principal ranging and laser designating device used by Army artillery forward observers with laser-energy homing munitions. It is capable of designating stationary or moving vehicular targets and may be used in a stationary, vehicle-mounted, or tripod supported dismounted mode.

e. *AN/VVS-1 Laser Range Finder mounted on the M60A2 Tank.*

f. *AN/VVG-1 Laser Range Finder mounted on the M551 A1 Sheridan vehicle.*

g. *Laser Augmented Airborne TOW (LAAT) mounted in the AH-1S COBRA Helicopter.* The LAAT system consists of a laser rangefinder and receiver that is incorporated into the M65 TOW telescopic sight unit.

h. *M55-Laser Tank Gunnery Trainer.*

i. *Multiple Integrated Laser Engagement System (MILES).* The MILES system uses low-risk lasers and does not require service members to wear protective lenses during the conduct of training with the MILES system.

j. *SHILLELAGH Conduct of Fire Trainer (SCOPT).*

k. *TASO Rifle Marksmanship-Weaponer-Remedial Rifle Marksmanship Trainer.*

19-4. Responsibilities

a. The Commanding General, US Army, Training and Doctrine Command (ATEN-S) will provide technical advice and assistance for establishing live fire and lasing ranges for using laser devices. For Department of the Navy activities technical assistance will be provided by Navy Electronics System Command (Code 7030).

b. The Surgeon General is responsible for the evaluation of potential optical radiation hazards in the ultraviolet, visible, and infrared spectrums to personnel who operate or maintain lasers, searchlights, and similar equipment used by the US Army (that generate optical radiation).

c. The Commanding General, US Army, Health Services Command, will, through the U.S. Army Environmental Hygiene Agency, survey installations to—

(1) Evaluate hazards to personnel operating laser devices and hazard control procedures for such sources.

(2) Make recommendations to protect personnel from exposure to potentially hazardous optical radiation from laser devices.

(3) Installation surveys for Department of the Navy Commands will be provided by Navy Electronic Systems Command (Code 7034).

d. Commanders of installations and activities will comply with this regulation in establishing ranges and nonlive fire training areas for laser use. They will also comply with directives in AR 40-46. Marine Corps installations will be guided by the provisions of NAVEX INST 5100.12.

e. Command safety managers will serve as principal staff advisors in monitoring the safe use of laser devices on their installations.

f. Firing or lasing unit commanders will—

(1) Determine, select, train, and safety certify the personnel needed to assist them in complying with this regulation (e.g., laser range safety officer (LRSO) and

laser range safety noncommissioned officer (LRSNCO) operators).

(2) Develop SOP for laser operations. Instruct personnel involved in laser operations to provide an understanding of the hazards for specific devices, allay unfounded fears, and prescribe the personal protective equipment to be used.

(3) Require personnel who have received eye or other overexposure to receive immediate medical treatment. Report overexposure to laser radiation to the installation surgeon within 24 hours. Maintain records of overexposure in excess of levels set forth in AR 40-46 and TB MED 279. NAVMEDCOM INST 6470.2 contains reporting requirements for Marine Corps Activities. Submit a message within 72 hours and a technical investigation report within 90 days after the occurrence to comply with procedures in chapter 9, AR 385-40. Army accident reporting policy includes processing DA Form 285 (US Army Accident Investigation Report) as a class D report for exposure-type occupational illnesses such as a (high intensity optical source (HIOS) accident (para 1-3c, AR 385-40).

(4) Provide adequate control of the target area to prohibit entry of unauthorized personnel.

g. The LRSO or LRSNCO will—

(1) Become familiar with this chapter and the FM and TM applicable to the particular laser devices to be used. Additional information on lasers is in appendix B.

(2) Brief unit personnel who work with laser devices, including an explanation of laser-related hazards and safety devices.

(3) Know the azimuths and elevations of each range, firing positions, and targets to be used.

(4) Insure protective eyewear is used when required.

(5) Insure compliance with the unit SOP for laser operations and training.

(6) Maintain continuous communication with personnel in the target area and stop lasing immediately if communication is lost.

(7) Stop lasing promptly if positive control of the laser beam is lost.

19-5. User level laser instructions.

a. See paragraph 19-4f(2).

b. In addition to instructions on particular laser devices or simulators, training material required for classroom instructors and range personnel should include—

(1) Principles of reflection or refraction of light.

(2) Hazards of laser beam to humans.

(3) Safety standards of operational control procedures.

(4) Preparation of range areas for laser use (e.g., insure that personnel have been alerted to laser hazard

and cover and remove, or avoid, lasing at specular surfaces).

c. Laser indoctrination should be provided at the same time as the basic weapons systems instruction to students taking advanced individual training and to officers taking basic courses. The classroom instructors must be knowledgeable in operator and crew aspects of laser safety. Reference publications on subject lasers should be readily available. The instruction presented should be at the user level. (Complex scientific data or terminology should be avoided.) A training film, if available, should be included in the instruction program. Hazard data for lasers as incorporated into TM and FM on the related weapon system or on the laser component should be stressed. Proper channels for obtaining professional safety and medical assistance should be addressed during indoctrination.

19-6. Range control procedures

a. The underlying concept of laser range safety is to prevent intrabeam viewing by unprotected personnel. This is done by locating target areas where no line of sight exists between lasers and uncontrolled, potentially occupied areas and by removing specular surfaces from targets.

b. Recommended target areas are those without specular (mirror-like) surfaces. Glossy foliage, raindrops, and other natural objects are not considered to be specular surfaces that would create ocular hazards.

c. If target areas have no flat specular surfaces, then range control measures can be limited to the control of the beam path between laser and backstop.

d. Laser devices will be lased at targets that are diffuse reflectors and will not be lased at specular reflective surfaces.

e. Specular surfaces within 30 meters of the laser target visible to unprotected personnel through binoculars or magnifying optics will be removed, covered, painted, or destroyed.

f. Unprotected personnel must not be exposed to either the direct beam or the beam reflected from a specular surface.

g. Evaluation of each anticipated operating condition must include development of procedures for (insuring) proper placement of warning signs. Local SOP should provide for the placement of temporary signs during operation. Signs should be in accordance with AR 385-30. See also figure 19-3.

h. Individuals within the laser surface danger zone (LSDZ), such as moving target operators, must wear laser protective eyewear with curved protective lenses during laser firing. Eyewear must be approved for the wavelength of the laser device being fired. A laser filter designed to protect against one wavelength of laser may not protect against harm from another. See table 19-3

for the wavelength and optical density required for the current fielded devices. If more than one type of device is used, protective measures must cover all devices. For devices of the same wavelength, the highest required optical density will be used.

i. The use of magnifying daylight optical devices to observe the target during laser operation is permitted if flat mirror-like surfaces have been removed from the target area. Mirror-like targets can be observed only if appropriate laser safety filters are placed in the optical train of the magnifying optics.

j. Calm, smooth water and clean ice can reflect laser beams, especially at low angles of incidence. Consider these potential reflections when establishing target areas.

19-7. Laser surface danger zone (LSDZ)

The lateral boundaries of the LSDZ include the horizontal buffer zones (fig 19-4). The uprange dimensions include Areas T and S, nominal ocular hazard distance (NOHD) nonmagnified distance, and (if applicable) magnified distance (fig 19-5). Tables 19-1 and 19-2 list these dimensions for current laser devices and, depending on the device to be used, should be applied in determining specific requirements. Figure 19-6 provides a realistic example of how an LSDZ applies to a training situation.

a. *Current surface danger zones.* Current surface danger zones for direct fire weapons generally provide the required buffer zones horizontally and vertically for laser operations used in the ground-to-ground mode provided the beam is terminated in the impact area (fig 19-4 and 19-7).

b. *Distance of the laser surface danger zone.*

(1) When viewing the collimated beam with a telescope, the hazardous range is greatly increased. For example, a 10km NOHD would be increased to 80km for an individual looking back at the laser from within the beam with 13 power optics. Such large amounts of real estate are difficult to control. The solution is to use a backstop behind the target.

(2) On the ground, this area normally extends to an adequate backstop or the NOHD. Lasing at targets on the horizon (no vertical buffer zone) is permitted as long as air space is controlled to the NOHD. In this case, the LSDZ extends downrange to the NOHD in the air space but only to the skyline on the ground as seen from the lasing position (fig 19-8). Operators and crews will lase only at approved targets. Usually, when there are no natural backstops available (e.g., mountains), the magnified (*indicates magnified) NOHD* may extend out to extremely long ranges (e.g., 80km for tank-mounted laser range finder (LRF)). This extreme situation would only create ocular hazards if—

(a) There was a direct line-of-sight to an ob-

server on the ground.

(b) There is a possibility that the observer could be engaged in direct intrabeam viewing with unfiltered magnifying optics.

(3) Unless the NOHD or NOHD* has been exceeded, the hazard distance of the laser device is the distance to the backstop. This hazard distance must be controlled. The terrain profile from the laser device's field of view plays a very important role since the laser presents only a line-of-sight hazard. The optimal use of natural backstops is the obvious key to minimizing laser range control problems.

c. *Buffer zones.* The extent of horizontal and vertical buffer zones around the target area, as viewed from the firing area, depends on the aiming accuracy and stability of the laser device. The laser horizontal buffer zones could partially or completely be included in lateral safety or ricochet areas on ranges where the laser is used with live fire weapons. Table 19-1 lists buffer zone values for currently fielded equipment.

19-8. Airborne laser operations

a. Airborne lasers will be lased into a controlled area that will accommodate the required LSDZ for each anticipated lasing point and provide controlled airspace out to the NOHD. The boundaries of the LSDZ will be clearly marked, visible, and recognizable from the lasing aircraft. Recommended permissible minimum and maximum aircraft elevations and aircraft pitch attitude for safe use of the laser should be determined to provide adequate buffer zones around targets located in the LSDZ. The range of the LSDZ will extend to the horizon as seen from the aircraft at the maximum permitted lasing altitude or to the NOHD or NOHD* for the laser if shorter. See figure 19-9.

b. When lasing operations from aircraft are directed into an area, such as a valley, that provides a positive natural backstop, the vertical buffer zone angle will be used to establish the downrange area required between the target and the range boundaries. Airspace must be controlled downrange of intended targets when standing water exists in the lasing area, if aircrews may be exposed to levels exceeding permissible exposure limits. See figure 19-10.

19-9. Operation outside range area

a. Maintenance in a controlled environment in accordance with established operating procedures may be performed with the ballistic cover removed.

b. Prefire checks that require operation of the laser can be made in a controlled area with the laser beam terminated by an opaque backstop. Prefire checks that do not require operation of the laser but require use of the optics can be safely made in a controlled area with the ballistic cover removed. This is done by instituting

operating procedures that insure power to the laser is turned off.

c. Tactical exercises can be conducted in a controlled area with the laser cover removed. This is done by instituting procedures that insure power to the laser is turned off.

d. The laser exit port must be covered when—

(1) The tank or other laser-equipped vehicle is traveling on range roads or moving from one area to another within the range and is not engaged in tactical/operations conducted in a controlled environment.

(2) The tank or other laser-equipped vehicle is

traveling on public highways.

(3) The tank is parked and not engaged in tactical exercises.

19-10. Tactical exercises

This regulation does not apply when using laser devices listed in table 19-1 in two-sided tactical exercises. The Surgeon General (HQDA (DASG-HDH)) or the Commandant of the Marine Corps (Code OT) should be consulted when planning these types of force-on-force training exercises so that appropriate laser safety precautions can be developed.

Table 19-1
Laser surface danger zone (LSDZ) dimensions

Device	t	NOHD Nonmagnified (M)	NOHD* Magnified (M)	Horizontal and vertical buffer zones	
				Static	Moving
AN/GVS-5 (Hand-held)	0	1,100	8,500	10 mils	NA
With 19dB Attenuator (Red Filter)	0	90	1,200	10 mils	NA
With 29dB Attenuator (Yellow Filter)	0	18	400	10 mils	NA
AN/PAQ-1 (Hand-held)	0	7,700	33,000	10 mils	NA
AN/PAQ-3 (Tripod) Designator	0	20,000	79,000	2 mils	NA
AN/PAQ-3 Rangefinder	0	6,500	35,000	2 mils	NA
AN/TVQ-2 (Tripod) Designator	0	25,000	80,000	2 mils	NA
AN/TVQ-2 Rangefinder	0	8,000	40,000	2 mils	NA
AN/VVG-2 (M60-A3)	10m	10,000	80,000	2 mils	5 mils
AN/VVG-1 (M551-A1)	10m	10,000	80,000	5 mils	Not permitted
AN/VVS-1 (M60-A2)	10m	10,000	80,000	5 mils	10 mils
LAAT(AH-1S)	0	5,000	30,000	NA	5 mils
M1 LRF (M-1)	0	7,000	35,000	2 mils	5 mils
TADS (AAH)	0	20,000 ³	70,000 ³	NA	5 mils
AN/ASQ-153 (A6-E)	0	10,000	49,000	NA	5 mils
AN/AVQ-25 (F-111)	0	16,000	52,000	NA	5 mils
AN/AAS-37 (OV-100)	0	11,200	56,200	NA	5 mils
AN/AAS-33A (A6-E)	0	14,600	58,000	NA	5 mils

Notes:

1. These devices can seriously injure the unprotected eye of individuals within the laser beam. Intrabeam viewing of either the direct beam or the beam reflected from specular surfaces expose personnel to a potential eye hazard. All distances are in meters. The buffer zones are based on the inherent accuracy of each laser. They do not compensate for untrained personnel, designating targets inaccurately, or improper target selection. Expand buffer zones for such situations.

2. NOHD*—Nominal ocular hazard distance with magnifying optics.

3. Pending evaluation of production model.

Table 19-2
NOHD for training lasers

<i>Device</i>	<i>NOHD (m)</i>	<i>NOHD*(m) ¹</i>
MILES (XM-63)	7	0
MILES (XM-65, XM-67, XM-64, XM-62)	12	75
MILES (XM-68, XM-251, XM-60 ² , XM-61 ²)	0	0
M55 (pulsed mode)	0	0
M55 (continuous mode) ³	0	0
TASO Rifle Marksmanship	0	0
SCOFT	13	160

Notes:

1. Nominal ocular hazard distance with optics.
2. The XM-60 and XM-61 are not hazardous during blank fire, but have an NOHD and NOHD* of 7 m and 0 m, respectively, during dry fire.
3. The M55 tank gunnery trainer is not a hazard for momentary (0.25 s) viewing at any range.

Table 19-3
Protective eyewear data*

<i>Device</i>	<i>Optical density</i>	<i>Wavelength/type</i>
AN/VVS-1	5.8	694.3nm/Ruby
AN/VVG-1	5.8	694.3nm/Ruby
AN/VVG-2	5.8	694.3nm/Ruby
AN/GVS-5	4.4	1064nm/NdYAG
GLLD	5.5	1064nm/NdYAG
MULE	5.6	1064nm/NdYAG
AN/PAQ-1	5.8	1064nm/NdYAG
LAAT	4.8	1064nm/NdYAG
AAH-TADS/PNVS	5.5	1064nm/NdYAG
M1 LRF(M-1)	4.7	1064nm/NdYAG
AN/ASQ-153	5.6	1064mm/NdYAG
AN/AVQ-25	5.8	1064mm/NdYAG
AN/AAS-37	5.6	1064mm/NdYAG
AN/AAS-33A	5.8	1064mm/NdYAG

*If more than one type device is used, protective measures must cover all devices. For devices of the same wavelength, the highest required optical density will be used.

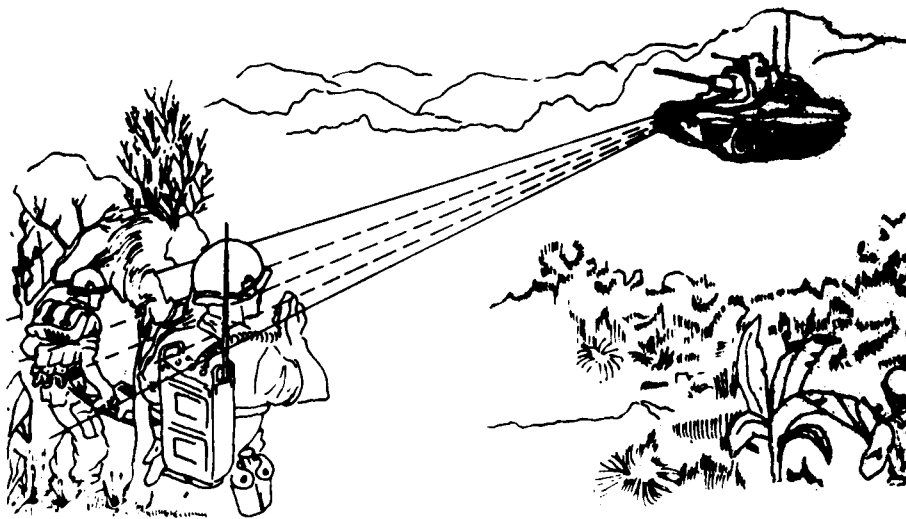


Figure 19-1. Direct intrabeam viewing

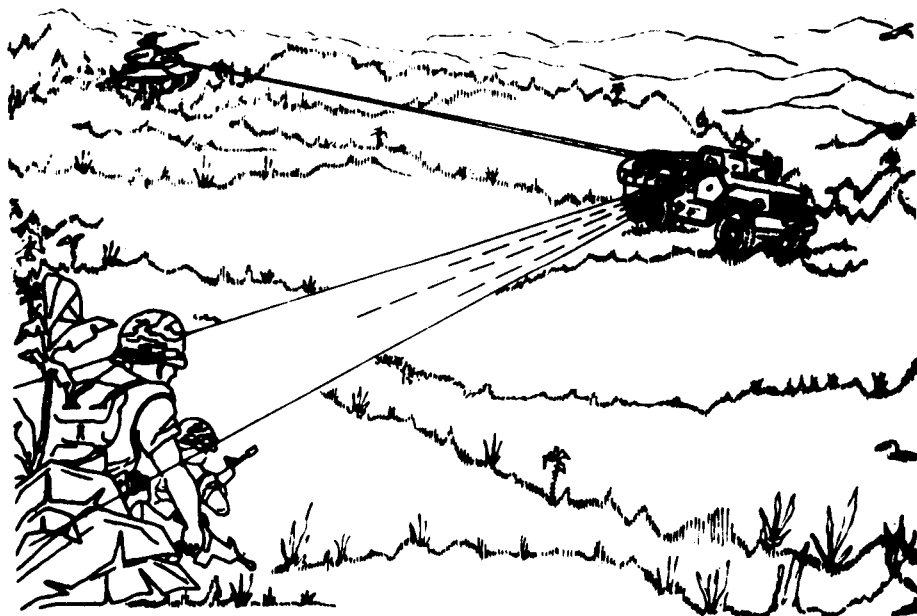


Figure 19-2. Reflected intrabeam viewing



Figure 19-3. Example warning sign

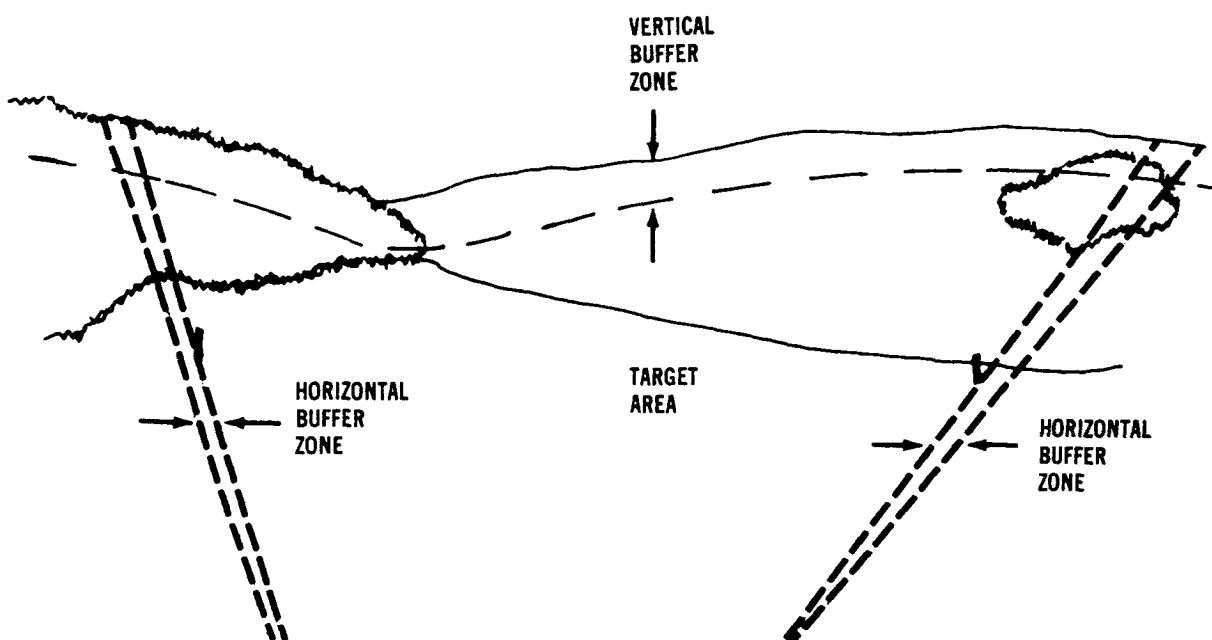


Figure 19-4. Horizontal buffer zone

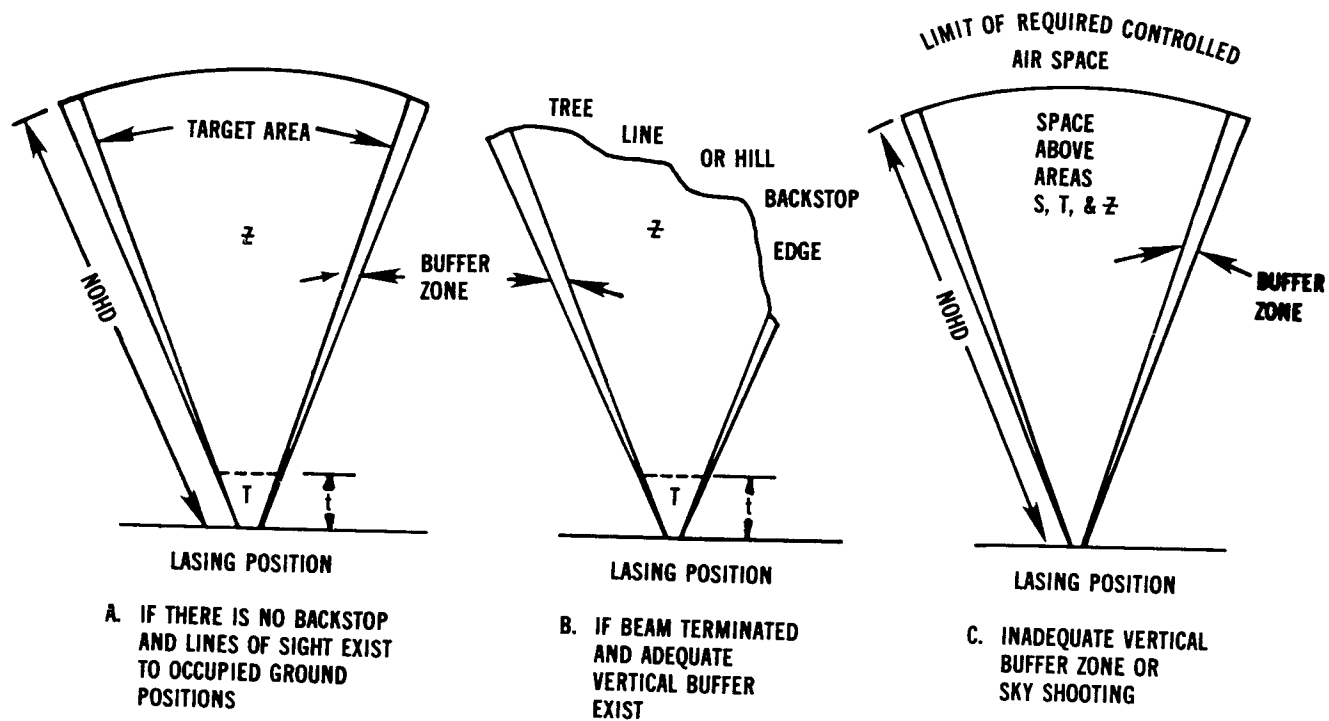


Figure 19-5. Laser range danger fan

CONDITION/SITUATION

M60 A3 WITH STABILIZATION AND LASER RANGEFINDER FIRING THE MAIN GUN WHILE MOVING. IN THE COMMANDER'S JUDGMENT, THE POSSIBILITY OF AN OBSERVER WITH MAGNIFYING OPTICS OBSERVING THE LASING TANK FROM A DISTANT GROUND POSITION BEYOND THE NOHD IS VERY REMOTE. THE AIRSPACE DOWNRANGE IS RESTRICTED OUT TO 10 KM.

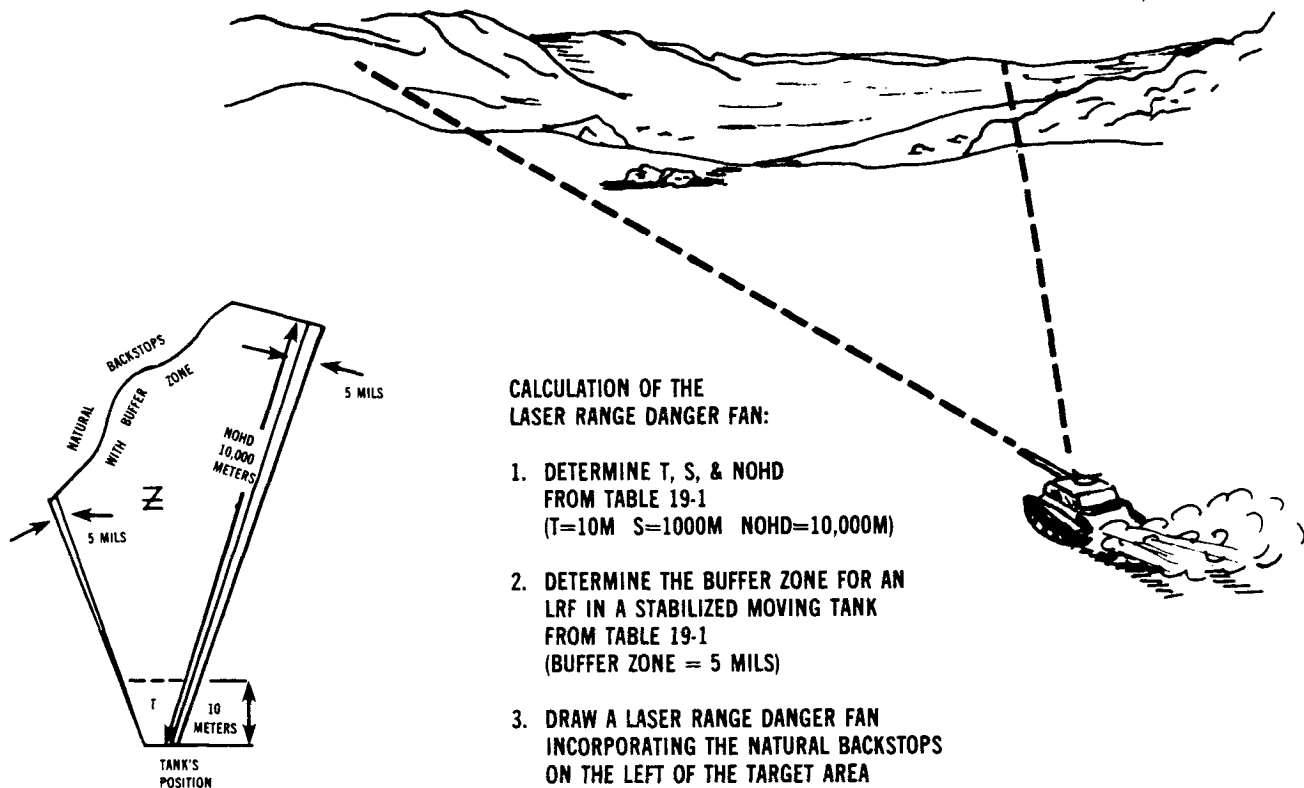


Figure 19-6. Example LRDF

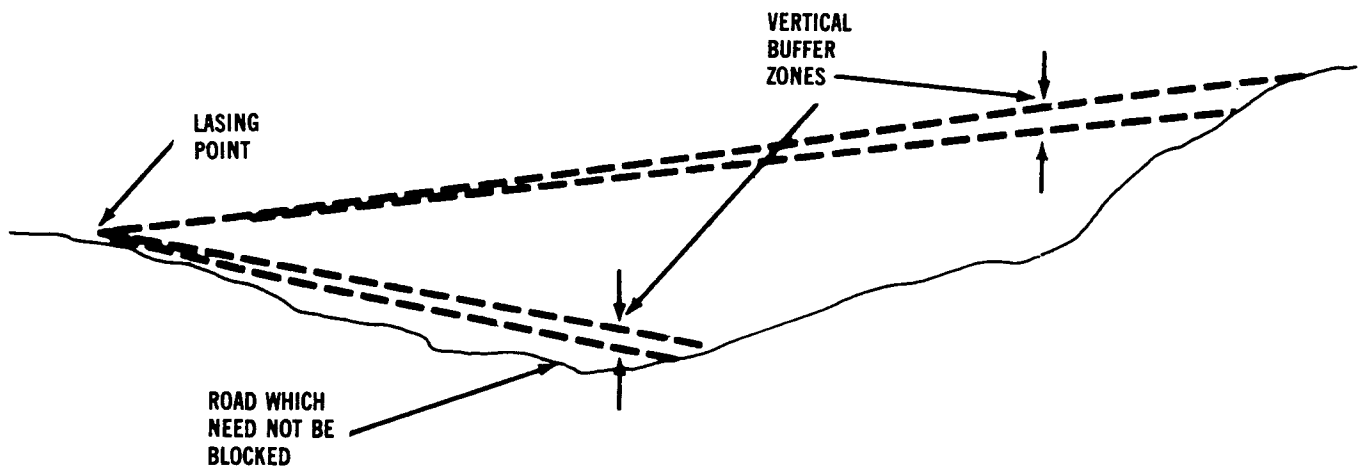


Figure 19-7. Vertical buffer zone

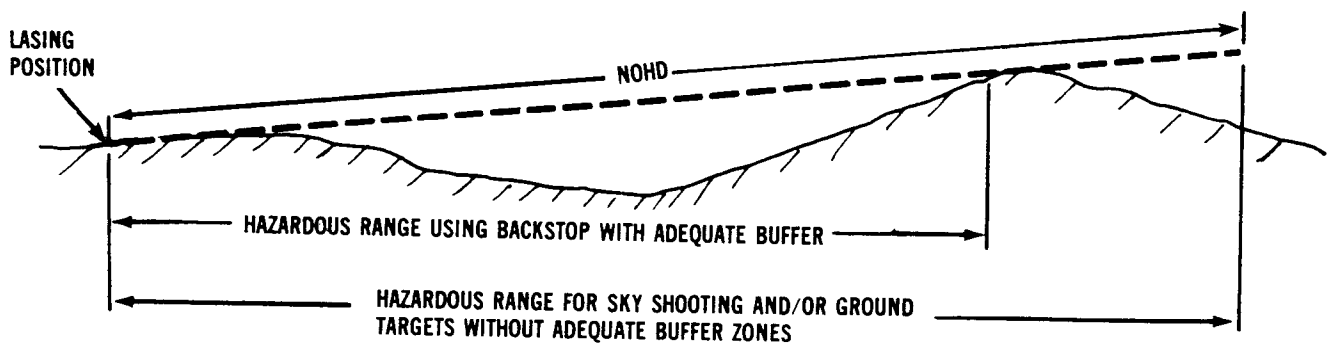


Figure 19-8. Effects of backstops

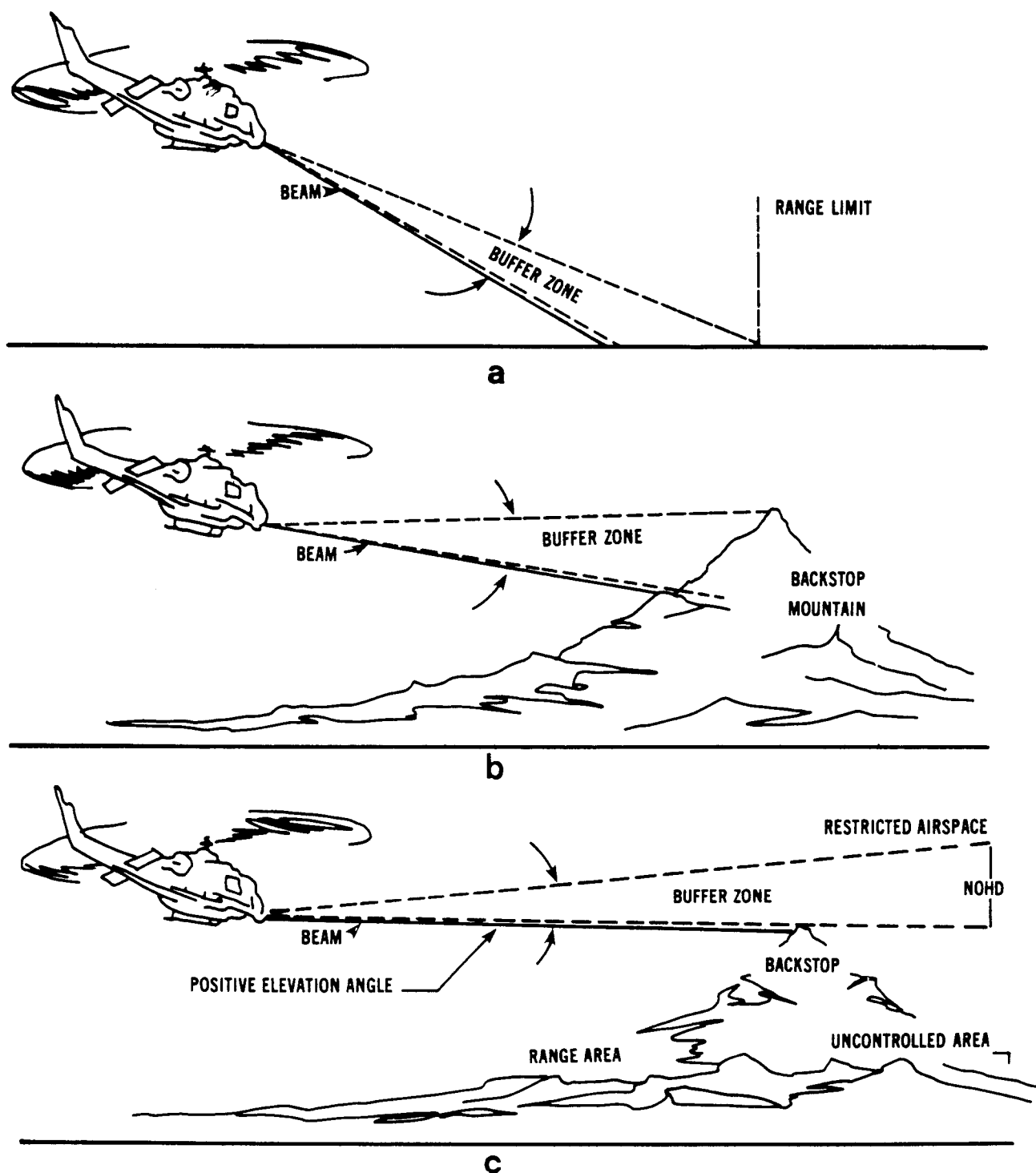
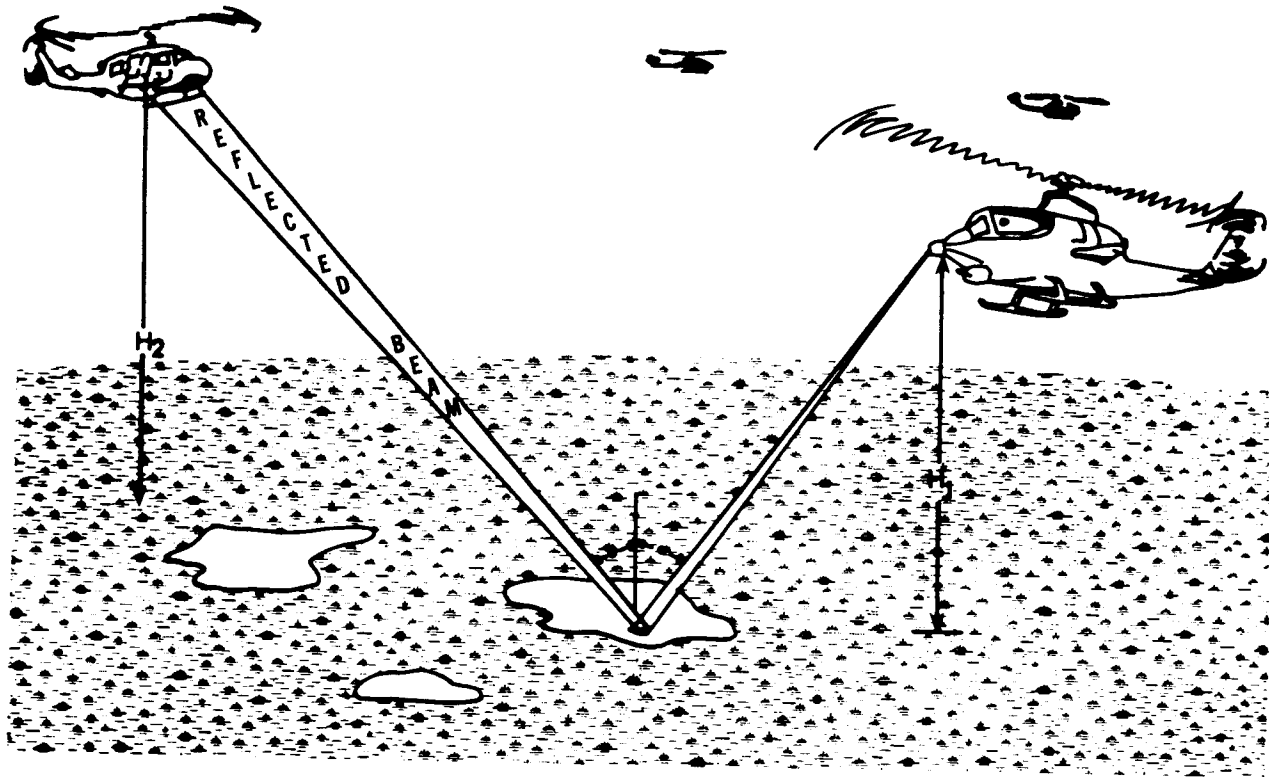


Figure 19-9. Examples of the use of natural backstops and buffer zones



THE SPECULARLY REFLECTED BEAM FROM AN AIRBORNE LASER GENERALLY IS OF GREATEST CONCERN WHEN ORIGINATING FROM STILL WATER. THE REFLECTED BEAM IS REDIRECTED UPWARD AT THE SAME ANGLE (θ) AS THE INCIDENT BEAM.

Figure 19-10. Example of airborne beam reflection

Appendix A References

Section I Required publications

AR 40-5	(Health and Environment). Cited in paragraph 2- <i>lm</i> .	AR 405-90	(Disposal of Real Estate). Cited in paragraph 2-9 <i>e</i> .
AR 40-46	(Control of Health Hazards from Lasers and other high Intensity Optical Sources). Cited in paragraph 19-4 <i>f</i> (3).	AR 700-68	(Storage and Handling of Compressed Gases and Gas Cylinders). Cited in paragraph 15-1 <i>a</i> (7).
AR 75-1	(Malfunctions Involving Ammunition and Explosives). Cited in paragraphs 3-3 <i>a</i> and 4-5 <i>d</i> (4).	FM 5-25	(Explosives and Demolitions). Cited in paragraph 18-2 <i>a</i> .
AR 75-15	(Responsibilities and Procedures for Explosive Ordnance Disposal). Cited in paragraph 18-2 <i>b</i> .	FM 5-15	(Field Fortifications). Cited in paragraphs 14-2 <i>c</i> and 16-4 <i>d</i> .
AR 95-1	(Army Aviation: General Provisions and Flight Regulations). Cited in paragraph 17-3 <i>c</i> .	FM 6-40	(Field Artillery Cannon Gunnery). Cited in paragraph 11-3 <i>c</i> .
AR 95-50	(Airspace and Terminal Instrument Procedures). Cited in paragraph 2-2 <i>b</i> and 2-2 <i>h</i> .	FM 6-50	(The Field Artillery Cannon Battery). Cited in paragraph 11-3 <i>c</i> .
AR 335-15	(Management Information Control System). Cited in paragraph 1-5 <i>f</i> .	FM 9-15	(Explosive Ordnance Disposal Service Service and Unit Operations). Cited in paragraph 2-10 <i>a</i> .
AR 385-30	(Safety Color Code Markings and Signs). Cited in paragraphs 2-8 <i>f</i> and 19-6 <i>g</i> .	FM 21-11	(First Aid for Soldiers). Cited in paragraph 7-2 <i>b</i> (3).
AR 385-40	(Accident Reporting and Records). Cited in paragraphs 3-5 <i>d</i> (4) and 19-4 <i>f</i> (3).	FM 21-40	NBC (Nuclear, Biological and Chemical) Defense. Cited in paragraph 7-2 <i>b</i> (3).
AR 385-64	(Ammunition and Explosives Safety Standards). Cited in paragraph 18-3.	FM 21-48	(Planning and Conducting Chemical, Biological, Radiological (CBR) and Nuclear Defense Training). Cited in paragraphs 17-1 <i>d</i> , 17-3 <i>b</i> , 17-4 <i>b</i> (2), 17-5 and 17-5 <i>b</i> .
AR 385-65	(Identification of Inert Ammunition and Ammunition Components). Cited in paragraph 18-12 <i>b</i> (1).	FM 21-75	(Combat Training of the Individual Soldier and Patrolling). Cited in paragraph 16-4 <i>h</i> (1).
		FM 23-30	(Grenades and Pyrotechnic Signals). Cited in paragraphs 7-1 <i>a</i> and 7-2 <i>b</i> (3).
		FM 23-65	(Browning Machinegun, Cal. 50, HB, M2). Cited in paragraph 16-4 <i>g</i> (3).
		FM 23-67	(Machinegun 7.62mm, M60). Cited in paragraph 16-4 <i>g</i> (3).

TM 3-1040-204-14	(Operator, Organizational, DS, GS Maint Manual, Flamethrower M2A1-7). Cited in paragraph 15-1a.	TF 9-6153	18-12a, 18-12b(1), and 18-12b(2).
TM 3-1040-209-12	(Organizational Maintenance Manual, Flamethrower, Mech, M10-8). Cited in paragraph 15-1a.	Code of Federal Register, Title 33	(Army Training Film—Planning and Conducting Range Clearance). Cited in paragraph 2-9d(8).
TM 9-1300-200	(Ammunition General). Cited in paragraph 18-12a.		(Navigation and Navigable Waters, Chapter II, Part 204). Cited in paragraph 2-3c.
TM 9-1300-206	(Ammunition and Explosives Standards). Cited in paragraphs 2-5d, 2-8a, 3-4b, 4-7, and 18-2a.	USAF Reg 60-18	(Air Force Participation in Static Displays and Actual Events). Cited in paragraph 16-7c.
TM 9-1330-200	(Grenades, Hand and Rifle). Cited in paragraph 7-2a. in paragraph 7-2a.	USAF TAC Reg 55-18	(Tactical Air Command Participation in Static Displays and Events). Cited in paragraph 16-7c.
TM 9-1345-203-12&P	(Operator's and Organizational Maintenance Manual for Land Mines). Cited in paragraph 18-12d.	MCO 3574.2	(Marksmanship Training with Individual Small Arms). Cited in paragraph 2-1m.
TM 9-1370-207-10	(Operators Manual for Pyrotechnic Simulators). Cited in paragraph 18-12f(3).	MCO 8025.1	(Class V(W) Malfunction and Deficiency Report). Cited in paragraphs 3-3a and 3-3b.
TM 9-1375-213-12	Operator's and Organizational Maintenance Manual for Demolition Materials). Cited in paragraph 18-12c(2).	Vol I, Naval Sea Systems Cmd Ord Pam 5	(Ammunition and Explosives Ashore (Safety Regs for handling, storage, production, renovation, and shipping)), Cited in paragraphs 2-5d, 2-8a, and 4-7. (Referenced publication available from CO NAV-PUBFORMCEN, 5801 Tabor Ave., Philadelphia, PA 19120.)
TM 9-6920-361-13&P	(Operator, Organizational and Direct Support Maintenance Manual for Field Arty Trainer Kits). Cited in paragraph 11-9b.	NAVELEX 5100.12	(Navy Laser Hazards Prevention Program) cited in paragraph 19-4(d).
TB MED 279	(Control of Hazards to Health from LASER Radiation). Cited 19-2b, 19-4f(3), and Annex A paragraph 3b.	NAVMEDCOM INST 6470-2	(Laser Radiation Health Hazards) cited in paragraph 19-4(f)(3)
TB 9-1300-385-1	(Munitions: Suspended or Restricted). Cited in paragraphs 3-2i(1), 3-2i(2), 3-2j, 3-3a, and 10-1a.		
TB 9-1300-385-2	(Munitions: Permanently Suspended or Restricted). Cited in paragraphs 3-2i(2), 3-2j, 3-3a, and 10-1a.		
Mil Std 709A	(Ammunition Color Coding). Cited in paragraphs	Section II Related Publications AR 200-1	(Environmental Protection and Enhancement)

15 October 1983

**AR 385-63
MCO P3570.1A**

AR 200-2	(Environmental Effects of Army Actions)		Rockets for Training, Tar- get Practice, and Combat)
AR 210-21	(Training Areas and Facili- ties for Ground Troops)	DA Pam 310-1	(Consolidated Index of Army Publications and Blank Forms)
AR 385-62	(Regulations for Firing Guided Missiles and Heavy		

Appendix B

Laser Information for Unit Laser Range Safety Officers

B-1. Information necessary for LRSO/LRSNCO

a. LASER means light amplification by stimulated emission of radiation. The effects of laser radiation are basically the same as optical radiation generated by more conventional ultraviolet, infrared, and visible light sources. The unique biological implications attributed to laser radiation result from the very high beam collimation, beam intensities, and single color (monochromaticity) of many lasers. The increased directional intensity of the optical radiation generated by a laser results in a concentrated optical beam ray of light at considerable distances.

b. Recent developments in laser technology have resulted in an increase in the use of these devices by the military, both for research and field use. Field military lasers are used principally for target acquisition and fire control. The widespread use of these systems increases the possibility of personnel exposure to injurious levels of laser radiation. Some laser devices are potentially hazardous, but, with adequate safeguards, the risk to personnel can be minimized.

B-2. Control measures

The laser system except for its inability to penetrate targets, can be treated as a direct-fire, line-of-sight weapon, such as a rifle or machinegun. Thus, the hazard control precautions taken with respect to the rifle or machinegun will provide most aspects of the safe environment required for laser use. Special control measures for laser use are discussed in *a* through *f* below.

a. The hazard from laser devices is limited to exposure to the unprotected eyes of individuals within the direct laser beam or a laser beam reflected from mirror-like surfaces. Serious eye damage with permanent impairment of vision can result to unprotected personnel exposed to the laser beam.

b. Essentially, the laser beam travels in a straight line, so it is necessary to provide a backstop, such as a hill behind the target during lasing operations. Calculated nominal hazardous ranges often extend even beyond 25 kilometers, and the use of optical viewing instruments within the beam could extend this hazardous range considerably (e.g., 80 kilometers). For this reason, and because of atmospheric effects on the beam, the designation of a single hazardous range for firing range safety purposes is not feasible for most testing and training purposes.

c. Every object that the laser beam strikes will reflect some energy back toward the laser. In most cases, this

energy is a diffuse reflection and is not hazardous. Certain shiny reflecting surfaces, however, must be avoided as targets to prevent reflection of a hazardous amount of radiation.

d. The use of optical devices to observe the target during laser operation will not be permitted unless flat mirror-like surfaces have been removed from the target area or unless appropriate laser safety filters are placed in the optical train of the binoculars or telescope.

e. Mirror-like reflections from standing snow or water do not present a hazardous situation to ground personnel not located along the azimuth of the beam path. These reflections do not present a hazard to personnel in aircraft outside the restricted airspace above the range.

f. Evaluation of each anticipated operating condition should include consideration and development of procedures for ensuring proper placing of warning signs for that operation. Local standing operating procedures should provide for the placement of temporary and permanent signs during such periods of operation. A sign such as shown in figure 9-3 should be used. The symbol on the temporary sign is red with black lettering on white background.

B-3. Personal protective equipment

This equipment consists of appropriate safety eyewear for individuals and filters for optical instruments such as binoculars, telescopes, and periscopes.

a. All eyewear and filters will be marked with their optical density (i.e., a measure of the attenuation afforded) at the specific wavelength for which they are to be used.

b. Selection will be in accordance with guidance provided in TB MED 524 (ref 1a) for the particular laser in use.

c. Eyewear and filters will be inspected for scratches, chips, and cracks, maintained in a clean condition, and replaced when inspection shows them to be no longer serviceable.

B-4. General safety requirements

a. A laser safety orientation will be given to all personnel who use or work with laser devices, to include an explanation of hazards and safety requirements.

b. To prevent injury to persons who do not have eye protection, the laser devices will not be lased at any surface at a range of 20 meters or less. Precautions, such as the removal of brush and trees, will be taken.

c. Personnel, such as moving target operators, who must be in the target area, will wear laser protective eyewear with curved protective lenses during laser firing. Such eyewear must be approved for the specific model

of laser device being fired. A laser filter designed for protection against one type of laser may not afford protection from another.

d. Laser devices will not be operated or experimented with when removed from the vehicle, unless specifically authorized by the appropriate maintenance manual.

e. The filters and protective goggles that have been developed for use with lasers are not required for training exercises when all personnel outside the target area comply with the provisions of this appendix.

f. Precautions, other than stated in chapter 19, are not required at night, or during rain, snow, or fog.

B-5. Range usage

Laser devices will be used only on those ranges that the installation commander has approved and established for such use.

a. Practice in lasing (i.e., use of only the lasing device) during nonlive firing exercises in training areas may be conducted only at those training areas that meet or exceed all safety requirements and have been approved for such use by the installation commander.

b. A survey of the proposed lasing and target area will be accomplished to establish laser elevation and azimuth limits. An adequate safety margin on either side of and above the beam extending out to a physical backstop is required.

(1) Laser safety stakes ordinarily will not be required at live-fire ranges because existing stakes designating right and left limits of fire provide an adequate margin of safety. If required, however, safety stakes will be emplaced under the direction and control of the installation range control officer.

(2) Laser safety stakes ordinarily will be required at local training areas approved for use of laser devices by command safety managers. These will be emplaced under the direction of the command safety manager and

will not be removed or moved without his knowledge and approval. Lasing (i.e., discharging the laser range-finder) will not be permitted at local training unless laser safety stakes designating right and left units of lasing are in place, or the command safety manager has determined that, because of the terrain configuration, such stakes are not required.

(3) Warning signs and barricades used to prevent personnel from entering firing areas also will be used in conjunction with lasing. Additionally, notice must be provided at the entrance to the range that laser operations are being conducted. (See fig 19-3).

c. Unprotected personnel will not be permitted in the established impact area as shown in the surface danger area diagram for the range.

d. Laser devices listed in table 19-1 will not be used in two-sided tactical exercises.

e. Flat mirror-like objects having a vertical or near vertical surface will be removed from within 30 meters of the target to prevent eye damage from a reflected laser beam. On moving tank ranges, generally those surfaces in which an image can be seen must be removed. The object may be covered or painted with lusterless paint if it cannot be removed. Beyond the 50-meter range from the target—reflective objects need not be removed. Laser devices, however, should not be intentionally fired at highly reflective surfaces at any range. Examples of flat mirror-like objects are—

- (1) Mirrors.
- (2) Chromeplated metal.
- (3) Panes of glass.
- (4) Retroreflective target material, such as Scotchlite.

f. The target material may be any surface that does not meet the description in table 19-1. Cloth, cardboard, wood, and lusterless metal of any size and color are acceptable as targets for lasing.

Glossary

Section I

Abbreviations

AGL	above ground level
ARSO	assistant range safety officer
ASO	aviation safety officer
ATGM	antitank guided missile
BATS	ballistic aerial target system
CALFEX	combined arms live-fire exercises
DARCOM	US Army Materiel Development and Readiness Command
EOD	explosive ordnance disposal
FAA	Federal Aviation Administration
FFAR	folding fin aerial rockets
HE	high explosive
ICM	improved conventional munitions
IP	instructor pilot
LASER	Light amplification by stimulated emission of radiation
LAW	light antitank weapon
LRSNCO	laser range safety noncommissioned officer
LRSO	laser range safety officer
LSDZ	laser surface danger zone
MEA	mission essential area
MFM	military family members
MRO	material release order
NBC	Nuclear, Biological, Chemical
NICP	national inventory control point
NOHD	nominal ocular hazard distance
NOHD*	nominal ocular hazard distance— magnified
OIC	officer in charge
RCO	range control officer
RO	range officer
RSO	range safety officer
SAA	small arms ammunition
SOP	standing operating procedure
TC	tank commander
WESS	weapons effect signature simulator

Section II

Terms

Assistant range safety officer (ARSO)

A qualified commissioned or warrant officer or non-commissioned officer (grade E6 or higher) designated by the OIC to assist the safety officer in carrying out the safety responsibilities for the range activities.

Center of impact

Center of the dispersion pattern of impact bursts. From the point of view of range only, it is the range center; from the point of view of deflection, the deflection center.

Clearances

a. Surface clearance. A range clearance where the surface area is searched visually and dud and other munition contamination are removed and disposed of properly. Surface-cleared ranges are restricted to activities that require no ground breaking and limited access.

b. Shallow clearance. A range clearance where the area is systematically swept with standard service mine detectors and all ferrous cased duds on the surface and down to a depth of 20–24 inches should be located, removed, and disposed of properly. The use of shallow cleared areas is restricted to activities causing only shallow surface disturbance, such as agriculture.

c. Moderate depth clearance. A range clearance, following surface and shallow clearance, to a depth of 3 feet, using a detector system more sensitive than the service mine detector. All items located are dug up and disposed of properly. Moderate depth clearance is required when an area is to undergo development.

d. Deep clearance. A range clearance that is usually only required at “point” locations (e.g., where deep underground utilities or the foundations of a large building are to be placed). The area is first cleared by use of mine detectors and then in 5-foot layers to the necessary depth.

Combined arms live fire exercise (CALFEX)

A combat exercise in which an Army/Marine Corps combined-arms team, in combat formation, conducts a coordinated combat firing and maneuver practice in executing the assault, seizure, and defense of appropriate objectives. Tactical air support may be included.

Contaminated area

Any area where there is known or suspected unexploded munitions regardless of type or the means by which they got there.

Cookoff

A functioning of any or all of the explosive components due to high temperatures within the weapon.

Direct fire

Fire delivered on a target when the piece is layed by sighting directly on the target, using the gun sighting equipment.

Downwind hazard area

The area beyond the impact point that may be affected

by a riot control chemical agent or by smoke due to downwind drift caused by wind direction and speed.

Firing lane

The area within which an aircraft or vehicle-mounted weapon is fired. It consists of a start firing line, cease-firing-disarm line, and left and right limits of fire.

Firing line

The line from which weapons are fired and forward of which no one is permitted during firing except as cited in this regulation.

Firing position

The point or location at which a weapon other than demolitions is placed for firing. (For demolitions, the firing position is the point or location at which the firing crew will be located during demolition operations.)

Fork

The change in angle of elevation necessary to produce a change to the center of impact equivalent to four probable errors.

Hangfire

A delay in functioning.

High-angle fire

Fire delivered at elevations greater than the elevation producing maximum range; fire, the range of which decreases as the angle of elevation is increased. Mortars deliver high-angle fire.

Instructor pilot (IP)

A qualified warrant or commissioned officer who is placed on military orders and is assigned the responsibility for the safe operation of assigned aircraft and weapon systems, including applicable aerial weapon systems (AR 95-1).

Laser particular terms:

a. Area S. A 30-meter radius around the target from which all specular surfaces should be removed, covered, painted, or destroyed.

b. Area T. The area within the established buffer zones, measured from the laser firing point to *t* meters uprange. No objects will be lased within Area T. Exposure hazard to the skin is insignificant compared to exposure to the eye, but personnel should avoid direct exposure to the unprotected skin up to *t* meters from the laser device.

c. Backstops. Opaque structures or terrain in the controlled area such as a hill, a dense tree line, or a windowless building, that would completely obstruct any view beyond it and completely terminate a laser beam that may miss the target.

d. Buffer zone. A safety margin on either side and above and below the approved target area, extending to a distance at which the beam is terminated by a back-

stop extending across the target zone, or the NOHD limit is reached. A vertical buffer zone covers the angular distances below the highest point on a backstop or above the nonlasing area. The laser horizontal buffer zone covers the angular distance to the left of the left-most target and the right of the right-most target (figs 19-4, 19-7).

e. Intrabeam viewing. Looking directly at the source of the beam or reflected beam from within the beam (figs 19-1 and 19-2).

f. Laser. A device capable of producing a narrow beam of intense light.

g. Laser range safety officer/laser range safety non-commissioned officer (LRSO/LRSNCO). A designated officer, warrant officer or noncommissioned officer of the firing unit who is responsible for ensuring compliance with the unit standing operating procedure for laser operations and training.

h. Laser rangefinder. A rangefinder employing a laser device to emit a pulsed laser beam that is aimed at the target. The range is determined automatically by electronically measuring the length of time it takes for the light beam to travel from the laser to the target, be reflected from the target, and return to the rangefinder.

i. Laser safety eyewear. Protective eyewear designed specifically to permit the user to be exposed to either the direct or reflected laser beam from specific laser devices without eye injury.

j. Laser surface danger zone (LSDZ). A V-shaped zone designed to contain the laser beam (while lasing) with buffer (safety) zones on either side, and above and below the approved target area.

k. Nominal ocular hazard distance (NOHD). The NOHD for direct intrabeam viewing is the minimum distance beyond which an unprotected person may stand in the beam and be exposed repeatedly without injury provided he or she does not look at the beam source with unfiltered magnifying optics.

l. Nominal ocular hazard distance-magnified (NOHD).* The NOHD for intrabeam viewing through magnifying optics with an 80mm objective and 7mm exit pupil.

m. Specular (mirror-like). A specular surface in which an individual can see his/her undistorted reflection. Examples of specular surfaces are: vehicle windows, vision blocks, searchlight cover glass, sheets of plastic, or mirrors.

Low-angle fire

Fire delivered at angles of elevation equal to or below that corresponding to the maximum range of the gun and ammunition.

Mask

Any natural or artificial obstruction that interferes with, or protects from, the observation of gun fire.

METRO

Variations in wind speed and direction, air temperature, and air density that cause changes in the predicted trajectory of a projectile or missile.

Misfire

A complete failure to fire, not necessarily hazardous, but, since it cannot readily be distinguished from a delay in functioning or hangfire, must be handled as worst case in accordance with procedures for the weapons system.

Mission essential area

The area within the surface danger zone located adjacent to the impact area that is allowed to be occupied only by essential personnel needed to accomplish the assigned task.

Officer in charge (OIC, WOIC, NCOIC)

The officer in charge of troops (or of the training of troops in a school situation) conducting firing on or using range facilities and having responsibility for the operation of the firing range.

Overhead fire

Fire that is delivered over the heads of unprotected friendly troops occupying Area D. Troops wearing steel helmets, "flak" jackets, and protective masks are considered unprotected. It does not apply to artillery crews occupying Area E due to approved tactical firing formations.

Probable error

Measure of the impact distribution in the dispersion pattern around the center of impact, dimensionally expressed in firing tables as one interval of the dispersion rectangle.

Range error

Difference between the range to the point of impact of a particular projectile and the range to the mean point of impact of a group of shots fired with the same data.

Range officer (RO)

A commissioned officer or civilian who supervises and enforces installation range safety and coordinates and schedules range use, maintenance, modification, and installation of ranges and training facilities in accordance with this regulation and the policies of the commander.

Range safety officer (RSO)

A qualified commissioned or warrant officer, or non-commissioned (E6 or higher) officer, who is the direct representative of the officer in charge of firing. The RSO is responsible to the OIC for insuring the adequacy of safety when firing is being conducted and for final determination that, before firing, settings placed on indirect fire weapons and ammunition represent data within prescribed safety limits.

Range personnel

Persons designated to assist the range officer in the discharge of his or her duties.

Registration fire

Fire conducted to determine the adjusted data required to place the mean burst location of rounds fired with that data at a point of known location. The adjusted data are used to determine corrections that when applied, will compensate for the cumulative errors contained in survey, the firing chart, material, and non-standard atmospheric conditions.

Safety radius

The distance from a weapon considered safe for personnel. It is also the minimum distance that troops will be kept away from a misfire, dud, or any potential explosion hazard and the distance required to move from a potential cookoff that cannot be cleared from the weapon.

Surface danger zone

That segment of the range area endangered by a particular type of weapon firing and consists of the following areas:

a. Target area. The point or location to which the weapon is to be fired. (For demolitions, the target area is the point or location at which the demolition charge is emplaced.)

b. Impact area. The primary danger area for indirect fire weapons that is established for the impact of all rounds. When applied to direct fire weapons, it is the area located between established range limits. The impact area is within the approved surface danger zone.

c. Ricochet area. The area between the impact area and Area A that parallels the line of fire. It is provided to contain ricochet projectiles.

d. Area A. The area (secondary danger area) that parallels the impact area laterally. It is provided to contain fragments from items exploding or ricocheting on the right or left edge of the impact area.

e. Area B. The area (secondary danger area) on the downrange side of the impact area and Area A. It is designed to contain fragments from items exploding on the far edge of the impact area.

f. Area C. The area (secondary danger area) on the uprange side of the impact area and parallel to Area B. It is designed to contain fragments from items exploding at the near edge of the impact area (also referred to as the short limit of the target area).

g. Area D. The area between Area C and Area E. It is a safe area for troop occupation for training purposes.

h. Area E. The area between Area D and the firing position. It is endangered by muzzle debris, overpressure, and injurious noise levels. Area E may be occupied only by weapon crews firing from an approved tactical configuration (circular, box, star, etc.).

i. *Area F.* The area immediately to the rear of a weapon or group of weapons. It is endangered by the effects of the weapon being fired.

j. *Near edge.* The boundary of the impact area that borders Area C and is nearest to the firing position.

k. *Far edge.* The boundary of the impact area that borders Area B and is farthest from the firing position.

l. *Safe area.* An area within the surface danger zone in which exposed personnel or those under cover may be located and the probability of their being injured from the effects of a normally functioning weapon, projectile, warhead, or munition is minimal.

m. *Primary danger area.* An area in which a hazard is known to exist and in which no unprotected personnel or equipment are permitted since injury to such personnel or damage to equipment is probable.

n. *Secondary danger area.* An area normally added to a primary danger area to provide for containment of the effects of projectiles or warheads that may function on the edge of a primary danger area or to contain fragments. No unprotected personnel or equipment are permitted in this area since injury to personnel or damage to equipment is probable.

o. *Downrange.* All areas of the surface danger zone located beyond the target point or center of a target area for multiple targets.

p. *Uprange.* All areas of the surface danger zone located between the firing position and the target point or center of a target area for multiple targets.

q. *Rear range.* The area to the rear of the firing position.

r. *Right range.* The uprange and downrange portion of the surface danger zone located to the right of the line of fire for a single weapon to a target point or the line of fire drawn from the center of a group of weapons to the center of the target area for multiple targets.

s. *Left range.* Same as right range, only left of the line of fire.

Vertical danger zone

A zone above the surface danger zone that provides for the containment of the flight of a projectile or projectile ricochet and the fragments of a projectile function above the surface. This zone consists of the sum of the items below:

a. *Maximum ordinate.* Difference in altitude between the origin and the highest point of the trajectory of a projectile.

b. *Maximum ricochet ordinate.* Difference in altitude between the origin and the highest point of the projectile in the air after it has hit and bounced. When firing at low gun quadrant elevations (less than 20 degrees), this altitude is generally equivalent to the maximum ordinate of 20 degrees quadrant elevation at the muzzle velocity of the weapon being fired. However, the impact media (i.e., hard ground or hard targets such as steel or concrete) may increase the potential maximum ricochet ordinate.

c. *Vertical secondary danger area.* An area normally added to the maximum ordinate or maximum ricochet ordinate to the effects of projectile or warhead that may function along the trajectory or above the surface. The value listed as Area A is used.

d. *Correction factor from standard atmosphere.* Factors to correct standard atmosphere conditions such as decrease in air density, decrease in air temperature, and head winds. Percent of maximum ordinate of ricochet ordinate follows:

- (1) For mortars—5 percent.
- (2) For guns—15 percent.
- (3) For recoilless rifles—8 percent.
- (4) For howitzer—9 percent.

Weapons instructor

A qualified individual who is appointed on military orders and who is assigned the responsibility for the safe operation of weapons systems. The orders include designated systems for which the WI is qualified as an instructor.

15 October 1983

AR 385-63
MCO P3570.1A

By Order of the Secretaries of the Army and the U.S. Marine Corps:

JOHN A. WICKHAM, JR.
General, United States Army
Chief of Staff

Official:

ROBERT M. JOYCE
Major General, United States Army
The Adjutant General

J. L. DAY
Major General, U.S. Marine Corps
Deputy Chief of Staff for Training

DISTRIBUTION: *Active Army, ARNG and USAR*: To be distributed in accordance with DA Form 12-9A requirements for AR, Safety—A.

Marine Corps

MARCORPS CODES: L71 plus 7000019, 159(5)
7500/7504028/7506004, 005, 008/7507016, 018, 020/7511001, 003, 004,
005, 017, 021/7553003/7600/7719004/7722002, 004, 005, 006/7726001
7729003/7731004/7747004/7752003/7792011/8200/8300/8302001
8350004, 005 (1)

Copy to: 8145001

